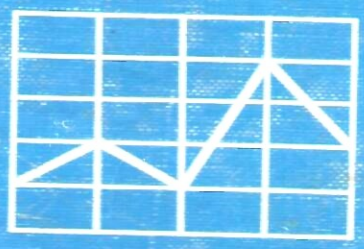
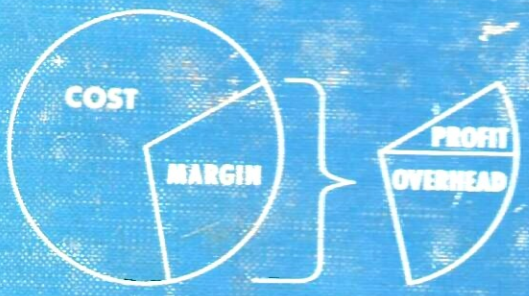
7

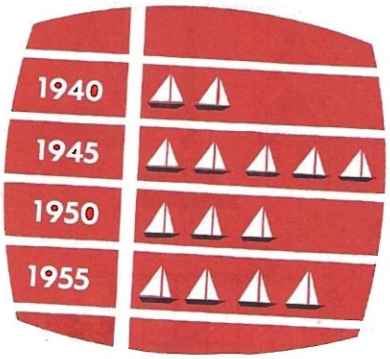
EXPLORING

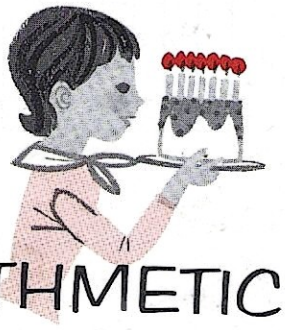
# Arithmetic



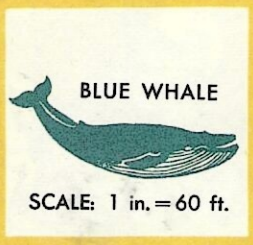


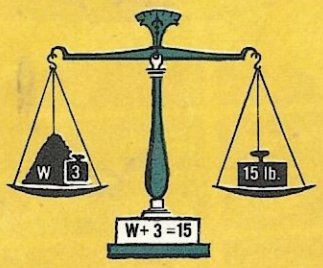
9B

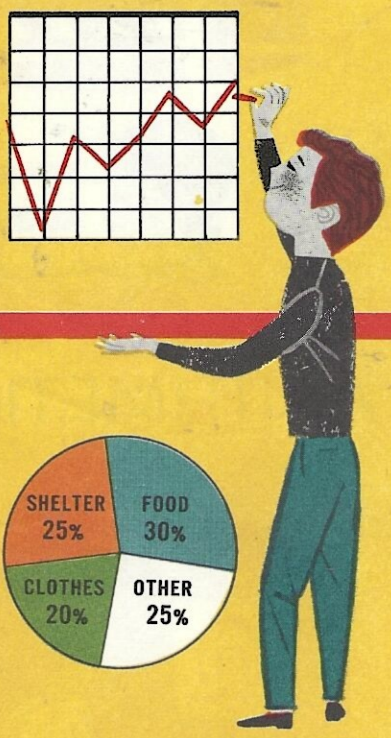


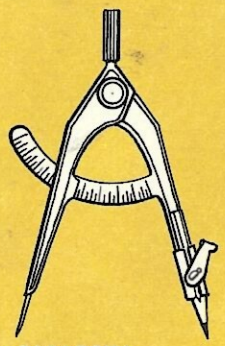



# EXPLORING ARITHMETIC





WEBSTER PUBLISHING COMPANY • ST. LOUIS • ATLANTA • DALLAS • PASADENA

EXPLORING

# Arithmetic

JESSE OSBORN ADELINE RIEFLING HERBERT F. SPITZER

# TABLE OF CONTENTS


UNIT ONE

1 . . . 24 — Reading and writing numbers • Roman numbers • Rounding numbers • Adding, subtracting, multiplying, and dividing with whole numbers • Problem solving

UNIT TWO

25 . . . 48 — The meaning of common fractions • Adding, subtracting, multiplying, and dividing with common fractions • Problem solving

UNIT THREE

49 . . . 72 — Learning and using the common units of measure • Measurement of angles • Measurement of time • Adding, subtracting, multiplying, and dividing units of measure • Problem solving

UNIT FOUR

73 . . . 96 — The meaning of decimal fractions • Adding, subtracting, multiplying, and dividing with decimals • Rounding of decimals • Changing common fractions to decimals • Problem solving

UNIT FIVE

97 . . . 122 — The meaning of per cents • Changing common fractions and decimals to per cents • Finding a per cent of a number • Finding per cents • Finding a whole from a part • Finding more than 100 per cent • Interest, commission, and discount • Percentage formulas • Problem solving

UNIT SIX

123 . . . 147 — Learning about lines, angles, and shapes • Measuring and drawing angles and shapes • Circles and compasses • Problem solving • SEMESTER TESTS

UNIT SEVEN

148 . . . 172 — Measuring lumber • Working with formulas • Finding areas of rectangles, triangles, squares, and parallelograms • Volume of rectangular solids • Working with circles • Problem solving

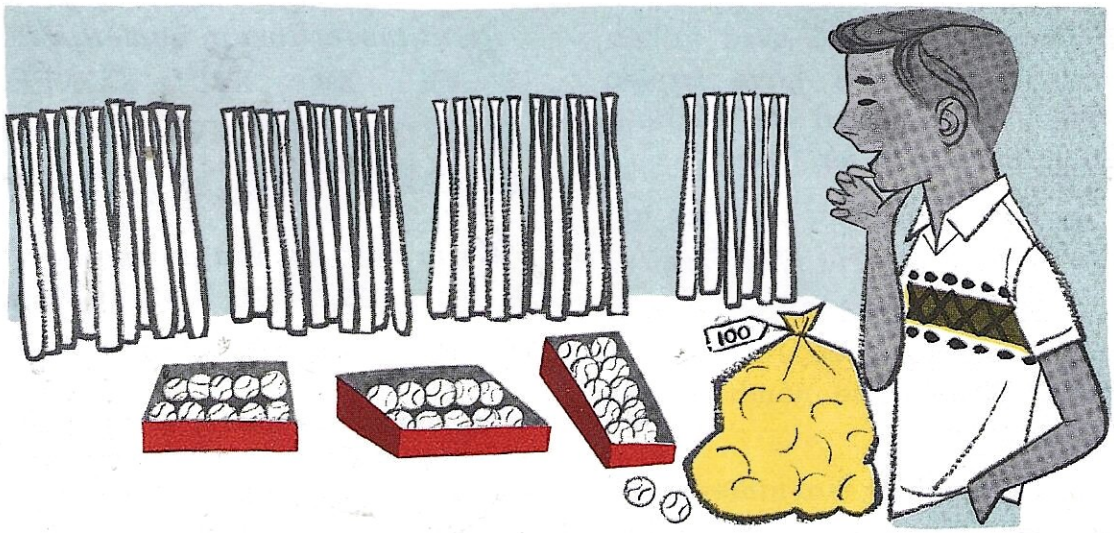


Library of Congress Catalog Card Number 57-5017


Copyright ©, 1957, by Webster Publishing Company


Printed in the United States of America

STOREROOM




## Estimating and Counting

The baseball season is over. All schools have turned in bats and balls. Damaged ones will be repaired or replaced. But first they must be counted. This is Jerry's assignment.

1. Jerry saw the bats first as in the picture on the opposite page. Look quickly. Estimate the number of bats. Do not count.

2. The picture on the opposite page also shows how Jerry first saw the balls. Look quickly. Estimate the number of balls. Do not count.

3. What is the difference between estimating and counting?

4. Before counting the bats, Jerry put them into groups of 10. See the picture above. Compare the time needed to count the bats in the picture on the opposite page and the time needed to count them in the picture at the top of this page.

5. Before counting the balls, Jerry put them into groups of 10 and groups of 100, as shown in the picture above. Compare the time needed to count the balls as seen in the two pictures.

All people have found it helpful to group objects for counting.

We often put things into groups of 10 and groups of 100 to make counting easy.

## Writing Numbers

▶ Jerry might have used tallies; that is, he could have written 𝍸 𝍸 to stand for 10 bats. Each line stands for 1 bat.

1. How many bats do these tallies show? 𝍸 𝍸 𝍸 𝍸 ///

2. Kay received 21 votes in a school election. Joe received 18 votes. Write these numbers with tallies.

3. Do you think that tallies would be useful in writing numbers like 493 or 2156? Why?

▶ The Romans used the tally idea in writing their numbers. These letters are Roman numerals.

| I | V | X | L | C | D | M |
|---|---|---|---|---|---|---|
| 1 | 5 | 10 | 50 | 100 | 500 | 1000 |

4. Explain how these numbers make use of the tally idea.

III VII XIII XX CCC DCCC

■ **In Roman numerals, repeating a numeral repeats the value.**

*Write with Roman numerals.*

5. One; three; ten; twenty

6. 100; 200; 1000; 3000

■ **In the Roman system, a numeral which comes after a larger numeral is added to the larger numeral.**

*Read these Roman numerals.*

7. VII XV XVI XXXVIII

8. LV LVI LXV LXVII CL CLX

9. CLXVII MDC MDCCXXIII

*Write with Roman numerals.*

10. 70; 72; 120; 122; 123

11. 600; 610; 620; 1100; 1350

■ **In Roman numbers, a numeral which comes before a larger numeral is subtracted from the larger numeral.**

12. In which of these Roman numerals is a smaller numeral subtracted from a larger numeral?

IV VII IX XI XL LXX XC

■ **In Roman numbers, when a numeral is between two larger numerals, the smaller numeral is subtracted from the numeral which is written after it.**

13. Read these Roman numbers.

XIV LIX DXC CXL MCDXCIV

14. Read these dates and tell what happened in these years. Explain the numerals.

MCDXCII MDCXX MDCCLXXVI

15. With Roman numerals write the numbers from 10 to 19; from 90 to 104; from 48 to 57.

## Arabic Numbers

In our number system we use Arabic figures.

1 2 3 4 5 6 7 8 9 0

*Write each of these numbers with both Arabic and Roman numerals.*

1. Three
2. Thirty
3. Three hundred
4. Three hundred thirty
5. Three hundred thirty-three
6. Three hundred three
7. Three thousand three hundred
8. Three thousand thirty
9. Three thousand three

In the Arabic number system the same figure may stand for many different numbers. In the examples above, the figure 3 stands for three, thirty, three hundred, and so on. Our 0 makes this possible. The Romans had no 0.

The Roman numeral I means one whenever it is written: I is one; II is one and one; III is one and one and one.

The Arabic figure 1 can stand for many different numbers: 1 is one; 11 is ten and one; 111 is a hundred and ten and one.

*Tell how many symbols are needed to write the numbers below (a) with tallies; (b) with Roman numerals; (c) with Arabic numerals.*

10. Eighty-eight
11. Eight hundred eighty-eight

The Romans did not use their numbers for figuring. A great advantage of our numbers is that we can use them for figuring, as well as for writing answers.

*Do what the signs tell you.*

12.

| | | | |
|---|---|---|---|
| 786 | 932 | 507 | 993 |
| 83 | 305 | 59 | 901 |
| 228 | 76 | 640 | 38 |
| 54 | 117 | 754 | 6 |
| +887 | +948 | +665 | +88 |

13. 760 + 156 + 938 + 447

14. XXV + XC + LVII + M

15.

| | | | |
|---|---|---|---|
| 875 | 642 | 903 | 720 |
| −178 | −506 | −337 | −234 |

16. 620 − 308 CD − LIX

17.

| | | | |
|---|---|---|---|
| 653 | 976 | 547 | 609 |
| ×702 | ×325 | ×240 | ×56 |

18. 38,796 ÷ 53 CXII ÷ VIII

## Ones, Tens, and Hundreds

Our school has many new books this year. Tom has tied the old ones into bundles of 10's and 100's to send them away. This list shows how Tom arranged the books.

| BOOKS | 100's | 10's | 1's |
|---|---|---|---|
| Spellers | 4 | 6 | 7 |
| Geographies | 3 | 7 | 0 |
| Histories | 2 | 0 | 8 |
| Dictionaries | | 2 | 4 |

1. Why did Tom tie the books into bundles of ten books first? Why did he put them in stacks of one hundred?

Remembering the 1's, 10's, and 100's in a number makes it easy to write the number.

2. You write the number of spellers as 467. What does the figure 4 tell? The figure 6? The figure 7?

3. Write the number of geographies. What does each figure tell?

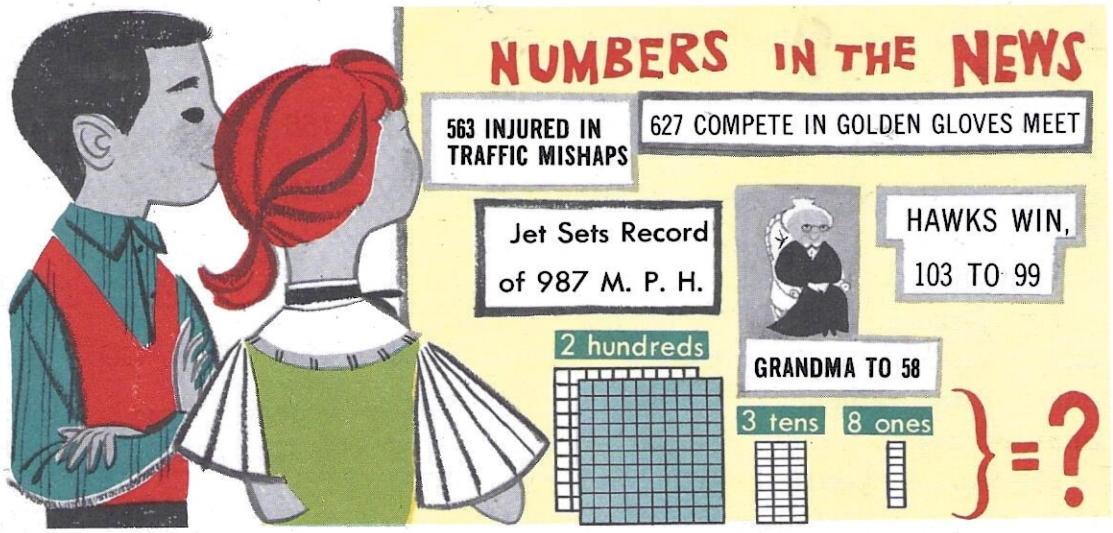
4. Write the number of histories. What does each figure tell?

5. Write the number of dictionaries. What does each figure tell?

*Write these numbers. What does each figure tell?*

6. Sixty-seven
7. Nine hundred
8. Five hundred forty-two
9. Seven hundred eight
10. Eight hundred forty
11. Three hundred thirty-three

12. Read each number on the bulletin board below.

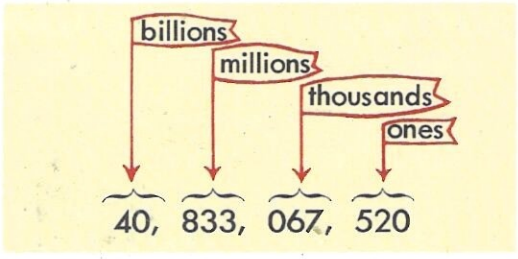


## Larger Numbers

Can you read this number? It tells the area in acres of the Pacific Ocean.

4 0 8 3 3 0 6 7 5 2 0

Dave said, "Easy. Begin at the right. Count the figures by threes. Write a comma to mark off each group of three.




"The last group at the left may have only two figures, or maybe only one. Each of the groups is called a *period*. Each period has a name.

"I read the number in the left period, and say the name of the period. Then I read the number in the next period, and say the name. I keep on until I have read every period, except that I do not say the name of ones period.

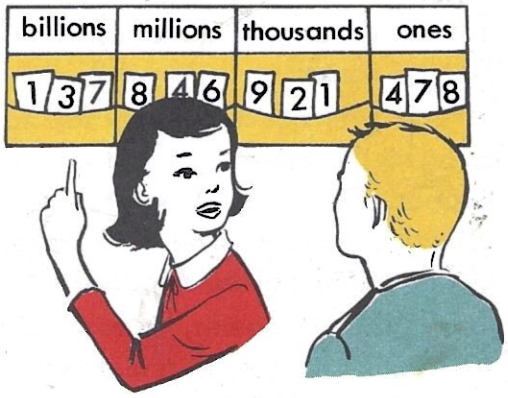
"I read the number as 40 billion 833 million 67 thousand 520."

■ **In arithmetic, the word period means a group of figures. It does not mean the dot used in punctuation.**

*Copy these numbers. Place commas to mark them off into periods. Read the numbers.*

| | | |
|---|---|---|
| 1. | 76548 | 7684971629 |
| 2. | 804653 | 18539014762 |
| 3. | 4398014 | 365278904562 |

Helen said, "I use a place-value frame when I have trouble reading large numbers. See how easy it is to read this number — 137 billion, 846 million, 921 thousand, 478."




*Copy and mark off into periods. Name the periods. Read the numbers.*

| | | |
|---|---|---|
| 4. | 7098440189 | 84607069008 |
| 5. | 23074390052 | 2000432520 |
| 6. | 18240302960 | 383427914337 |
| 7. | 65784319 | 65438765407 |
| 8. | 987630421 | 765093186243 |

## Rounding Numbers

1. Tom said the distance to Philadelphia was about 100 miles. Was he right?

He rounded up from 98 miles to 100 miles.

2. Tom said the population of Highland City was about 2000. Did he round up to a larger number or down to a smaller number?

3. The road map gave the population of the state as 3,291,718. Tom said this was about 3,000,000. Did he round up or down?

4. It was not necessary for Tom to have the exact count of miles or people. Why not? Can you think of other cases when an exact count would not be needed?

5. What is easier, to remember an exact count, or to remember the whole hundred, or whole thousand, or whole million that is closest to the exact count?

6. What is the whole hundred closest to each of these numbers?

178 493 521 649 751 833

■ **When the exact number is midway between two whole hundreds, round it to the larger of the whole hundreds.**

You round 250 to 300. You round 650 to 700.

7. Round to the nearest hundred.

450 671 642 250 973 850

8. What is the whole thousand closest to each of these numbers?

1489 2437 7521 9499

9. Round to nearest thousand.

7501 2479 8500 6744

10. Round to the nearest million.

7,532,118 163,905,216
78,397,475 549,498,990

11. The distance around the earth at the equator is about 24,902 miles. Round to the nearest thousand miles.

12. The distance from earth to the moon is about 238,857 miles. Round to nearest thousand miles.

13. Round the figures in this table to the nearest million.

| ACRES OF FARM LAND IN THE U. S. | |
|---|---|
| Crop Land | 321,757,900 |
| Pasture | 267,992,295 |
| Woodland | 1,453,774,019 |
| Wasteland | 76,490,496 |

## Counting Forward and Backward

1. Tim can count forward by 6's very fast. Can you? How can counting by 6's help you in arithmetic?

▶ Practice counting forward with the numbers below. For example, begin with 23 and count by 6's. Write the first number larger than 50 that you count.

Count: 23; 29; 35; 41; 47; 53.
Write: 53.

| | Begin with | Count forward by | | |
|---|---|---|---|---|
| 2. | 19 | 2 | 5 | 7 |
| 3. | 26 | 3 | 6 | 8 |
| 4. | 31 | 4 | 7 | 9 |
| 5. | 23 | 3 | 5 | 8 |
| 6. | 24 | 4 | 6 | 9 |

▶ Write the first number larger than 100 that you count.

| | Begin with | Count forward by | | |
|---|---|---|---|---|
| 7. | 65 | 4 | 7 | 9 |
| 8. | 54 | 5 | 6 | 8 |
| 9. | 62 | 3 | 5 | 7 |
| 10. | 71 | 2 | 6 | 9 |

11. John had 28¢. Bill and Tom each paid him 9¢. How much does John have now?

12. Mary can count backward by 7's. How will this help her in arithmetic?

▶ Practice counting backward with the numbers below. Write the first number less than 20 that you count. For example, begin with 58 and count backward by 7's.

Count: 58; 51; 44; 37; 30; 23; 16.
Write: 16.

| | Begin with | Count backward by | | |
|---|---|---|---|---|
| 13. | 53 | 3 | 5 | 4 |
| 14. | 41 | 2 | 6 | 8 |
| 15. | 64 | 5 | 7 | 9 |

16. Tom had 23 rabbits. He gave 4 each to Fred, Joe, and Sam. How many rabbits does he have now?

17. Bob had 25 tickets to sell for a school entertainment. He sold 4 each to the Browns and to the Smiths. How many did he have left?

▶ Count backward as far as you can. Write the last number you count.

| | Begin with | Count backward by | | |
|---|---|---|---|---|
| 18. | 22 | 3 | 4 | 5 |
| 19. | 41 | 5 | 6 | 7 |
| 20. | 47 | 7 | 8 | 9 |

21. Helen had 23 caramels. How many did she have left after giving 6 each to Sue, Joy, and Mary?

## Improving Your Addition

Mr. Hall wanted to hire a boy to work in his store. He asked each boy who applied for the position to prove that he was good in arithmetic. Here is one column of numbers that they had to add.

addends
864
793
838
147
621
+733
sum → 3996

These are the keys to success in adding.

1. **Know the basic addition facts.**
2. **Know how to add a column.**
3. **Know how to carry.**
4. **Know how to check your work.**

1 It is very important to know how to add rapidly and correctly. One of the most helpful things is to know the basic addition facts.

■ **The basic addition facts are all the additions in which one 1-figure number is added to another 1-figure number.**

You use the basic addition facts whenever you add. Do you see why these facts are called "basic"?

*Find these sums.*

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | 8 | 5 | 8 | 7 | 2 | 6 |
| | +7 | +2 | +4 | +7 | +9 | +9 |
| 2. | 8 | 6 | 4 | 4 | 3 | 8 |
| | +8 | +2 | +5 | +2 | +3 | +6 |
| 3. | 5 | 5 | 2 | 7 | 8 | 7 |
| | +7 | +6 | +2 | +6 | +5 | +9 |
| 4. | 3 | 4 | 7 | 8 | 3 | 5 |
| | +9 | +4 | +4 | +2 | +8 | +3 |
| 5. | 5 | 6 | 3 | 9 | 4 | 9 |
| | +5 | +6 | +2 | +5 | +3 | +8 |
| 6. | 7 | 6 | 9 | 3 | 2 | 9 |
| | +3 | +4 | +9 | +6 | +7 | +4 |

*Review the basic addition facts on page 296.*

2 When adding a column of 1-figure numbers, it is often necessary to add 1-figure numbers to 2-figure numbers.

When you add the endings, you are using the basic addition facts. Look at this example.

| | Think this: |
|---|---|
| 9 | |
| 4 | 9+4=13 |
| 6 | 13+6=19 |
| 5 | 19+5=24 |
| +3 | 24+3=27 |
| 27 | |

*Say the answers. Which basic addition facts are used?*

| | | | | | |
|---|---|---|---|---|---|
| 7. | 3 | 13 | 23 | 33 | 43 |
| | +6 | +6 | +6 | +6 | +6 |
| 8. | 9 | 19 | 29 | 39 | 49 |
| | +5 | +5 | +5 | +5 | +5 |

*Hold paper under each row and write the sums.*

| | | | | | |
|---|---|---|---|---|---|
| 9. | 5 | 7 | 3 | 2 | 1 |
| | 9 | 8 | 8 | 7 | 2 |
| | 4 | 3 | 7 | 6 | 7 |
| | 6 | 9 | 6 | 2 | 2 |
| | 4 | 1 | 1 | 9 | 5 |
| | +6 | +9 | +7 | +4 | +4 |
| 10. | 1 | 2 | 3 | 5 | 6 |
| | 4 | 7 | 3 | 6 | 7 |
| | 7 | 3 | 2 | 5 | 8 |
| | 2 | 4 | 9 | 3 | 3 |
| | 6 | 9 | 3 | 7 | 9 |
| | 9 | 7 | 4 | 5 | 9 |
| | +4 | +5 | +5 | +4 | +7 |
| 11. | 9 | 7 | 8 | 3 | 9 |
| | 5 | 1 | 2 | 9 | 1 |
| | 8 | 1 | 4 | 3 | 7 |
| | 4 | 4 | 5 | 6 | 2 |
| | 2 | 5 | 4 | 2 | 6 |
| | 0 | 2 | 8 | 6 | 3 |
| | +7 | +8 | +4 | +5 | +6 |
| 12. | 8 | 7 | 6 | 7 | 9 |
| | 6 | 9 | 4 | 5 | 2 |
| | 5 | 8 | 5 | 7 | 8 |
| | 6 | 9 | 2 | 1 | 4 |
| | 9 | 4 | 6 | 6 | 9 |
| | 9 | 9 | 4 | 8 | 7 |
| | +6 | +2 | +7 | +8 | +4 |

3 Knowing how to carry is very important in addition. Study the examples below. What was done to the 15 ones?

| | | |
|---|---|---|
| 48 = 4 tens | 8 ones | |
| +27 = 2 tens | 7 ones | |
| 6 tens | 15 ones | |
| = 7 tens | 5 ones | = 75 |

What was done to the 15 tens in this example?

| | | |
|---|---|---|
| 480 = 4 hundreds | 8 tens | |
| +270 = 2 hundreds | 7 tens | |
| 6 hundreds | 15 tens | |
| = 7 hundreds | 5 tens | = 750 |

**Changing 10 ones to a ten or changing 10 tens to a hundred is called carrying.**

*Find the sums.*

| | | | | |
|---|---|---|---|---|
| 13. | 166 | 639 | 258 | 486 |
| | +327 | +256 | +539 | +381 |

Sometimes you carry 1, as in the examples above. Sometimes you carry 2, or more, as below.

| | | | | |
|---|---|---|---|---|
| 14. | 387 | 549 | 107 | 748 |
| | 146 | 367 | 498 | 159 |
| | 458 | 673 | 905 | 163 |
| | +187 | +456 | +432 | +984 |
| 15. | 549 | 663 | 737 | 598 |
| | 758 | 238 | 404 | 639 |
| | 583 | 438 | 119 | 237 |
| | 772 | 207 | 764 | 993 |
| | +178 | +286 | +199 | +387 |

4 It is important for you to know how to check your addition.

Jack, Tom, and Jim checked their addition in three different ways. Jack added the columns down and checked by adding up.

Tom broke the columns into two parts. He added each part and added their sums.

Jim used the mark-out check. He crossed out the top addend and wrote it below the sum. Then he crossed out the sum, and added with the top addend at the bottom.

| 864 | TOM |
|---|---|
| 793 | |
| +838 | |
| 147 | 2495 |
| 621 | |
| +733 | |
| 3996 | +1501 |
| | 3996 |

~~864~~ JIM
793
838
147
621
+733
~~3996~~
+864
3996

Add the examples in the next column. Check each answer by all three methods.

Which way of checking do you like best? Why?

| | | | | |
|---|---|---|---|---|
| 292 | 697 | 373 | 647 | 684 |
| 596 | 707 | 288 | 4 | 804 |
| 794 | 745 | 173 | 83 | 160 |
| 838 | 407 | 387 | 624 | 56 |
| 218 | 988 | 241 | 19 | 24 |
| +484 | +656 | +161 | +988 | +187 |

### Addition Races

Use the examples below to race with a partner who can add about as fast as you can. Add and check. Exchange and mark papers after each race. Rework any examples you miss.

RACE I

| | | | |
|---|---|---|---|
| 458 | 673 | 905 | 163 |
| 187 | 456 | 432 | 984 |
| 545 | 663 | 737 | 593 |
| 758 | 238 | 404 | 639 |
| 583 | 438 | 119 | 237 |
| +772 | +201 | +764 | +993 |

RACE II

| | | | |
|---|---|---|---|
| 78 | 545 | 283 | 717 |
| 643 | 900 | 4068 | 826 |
| 9 | 86 | 252 | 49 |
| 77 | 143 | 2164 | 730 |
| 460 | 2 | 91 | 57 |
| +6 | +97 | +8643 | +908 |

RACE III

| | | | |
|---|---|---|---|
| 748 | 375 | 486 | 379 |
| 145 | 629 | 603 | 379 |
| 882 | 149 | 642 | 894 |
| 185 | 448 | 627 | 573 |
| 882 | 187 | 950 | 638 |
| +118 | +849 | +648 | +137 |

RACE IV

| | | | |
|---|---|---|---|
| 882 | 93 | 3230 | 33 |
| 77 | 709 | 80 | 694 |
| 703 | 456 | 694 | 65 |
| 49 | 65 | 234 | 644 |
| 6 | 186 | 1894 | 8 |
| +899 | +15 | +628 | +62 |

## Improving Your Subtraction

Boys who wanted to work in a store were given this example:

7803 minuend
−4825 subtrahend
2978 difference or remainder

They knew that in order to be hired they would have to get every subtraction example right.

These are the keys to success in subtracting.

1. **Know the basic subtraction facts.**
2. **Know how to borrow.**
3. **Know how to borrow when the minuend has one or more zeros.**
4. **Know how to check.**

1 Notice that the basic subtraction facts are related to the basic addition facts.

| | | | |
|---|---|---|---|
| Subtraction Facts | 12 − 6 = 6 | 13 − 8 = 5 | 13 − 5 = 8 |
| Related Addition Facts | 6 + 6 = 12 | 5 + 8 = 13 | 8 + 5 = 13 |

Copy each subtraction question at the top of the next column and write the difference. Then write the basic subtraction and addition facts that are related to it.

| | | | | | |
|---|---|---|---|---|---|
| 1. | 15 − 9 | 14 − 6 | 16 − 9 | 18 − 9 | 17 − 8 |
| 2. | 15 − 7 | 16 − 8 | 12 − 7 | 12 − 9 | 11 − 2 |
| 3. | 11 − 9 | 15 − 6 | 13 − 5 | 11 − 8 | 15 − 8 |
| 4. | 14 − 9 | 16 − 7 | 11 − 6 | 10 − 4 | 12 − 6 |
| 5. | 14 − 7 | 14 − 8 | 13 − 6 | 10 − 2 | 14 − 5 |
| 6. | 12 − 4 | 17 − 9 | 13 − 4 | 11 − 4 | 12 − 8 |
| 7. | 12 − 5 | 13 − 8 | 13 − 7 | 11 − 5 | 13 − 9 |

*Review all the basic subtraction facts on page 297.*

2 You cannot subtract correctly unless you know how to borrow. Copy, finish, and explain these examples.

8. 83 = 7 tens 13 ones
   −26 = 2 tens 6 ones

9. 830 = 7 hundreds 13 tens
   −260 = 2 hundreds 6 tens

■ **In subtraction, changing a ten to 10 ones or changing a hundred to 10 tens is called borrowing.**

*Copy the examples below and write the answers.*

| | | | | |
|---|---|---|---|---|
| **10.** | 863 − 127 | 570 − 238 | 746 − 327 | 552 − 349 |
| **11.** | 835 − 186 | 746 − 297 | 920 − 348 | 527 − 288 |
| **12.** | 533 − 282 | 745 − 393 | 867 − 480 | 936 − 245 |
| **13.** | 763 − 405 | 986 − 577 | 738 − 459 | 652 − 564 |

**3** When there are 0's in the minuend, you cannot always borrow the usual way. Study the examples below. Be able to explain each step.

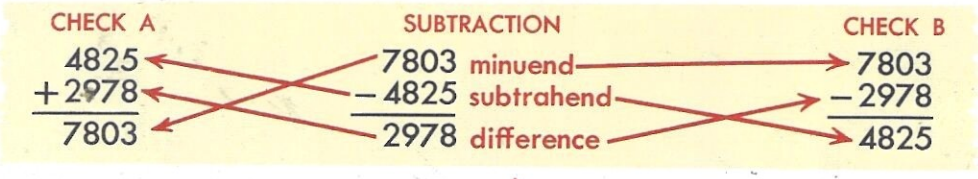
$802 = 80$ tens $2$ ones $= 79$ tens $12$ ones
$-237 =$ $23$ tens $7$ ones
$56$ tens $5$ ones $= 565$

$4002 = 400$ tens $2$ ones $= 399$ tens $12$ ones
$-1735 =$ $173$ tens $5$ ones
$226$ tens $7$ ones $= 2267$

*Write the answers.*

| | | | | |
|---|---|---|---|---|
| **14.** | 600 − 318 | 403 − 245 | 700 − 336 | 905 − 408 |
| **15.** | 301 − 8 | 704 − 9 | 200 − 7 | 903 − 5 |
| **16.** | 500 − 32 | 602 − 48 | 701 − 75 | 800 − 96 |
| **17.** | 702 − 205 | 803 − 195 | 605 − 277 | 404 − 99 |
| **18.** | 9001 − 2875 | 7003 − 1756 | 5040 − 2290 | 8000 − 1763 |
| **19.** | 3004 − 196 | 5010 − 437 | 4002 − 885 | 7030 − 567 |
| **20.** | 5007 − 98 | 4012 − 75 | 6103 − 57 | 4205 − 98 |
| **21.** | 7002 − 309 | 5011 − 208 | 8100 − 78 | 6010 − 909 |
| **22.** | 752 − 138 | 964 − 339 | 886 − 279 | 6904 − 3456 |
| **23.** | 963 − 487 | 740 − 246 | 825 − 379 | 6308 − 1539 |

**4** Checking your work is an important part of subtraction. Study the two ways of checking shown. Which method do you like better? Why?




▶ In Check A, the subtrahend and the difference are added. This gives the minuend.

▶ In Check B, the difference is subtracted from the minuend. This gives the subtrahend.

*Copy and work examples 18 and 23 on page 12. Use both methods to check your answers.*

## Rounding Numbers

▶ Often exact numbers are not needed. With rounded numbers you can find approximate answers quickly. Approximate answers are answers which are very near to the exact answer.

1. Jack headed a committee to count books in the school storeroom. Jack was asked to report the approximate number of books.

The list below tells how many books the committee counted. They rounded each total to the nearest hundred. What number is the approximate total?

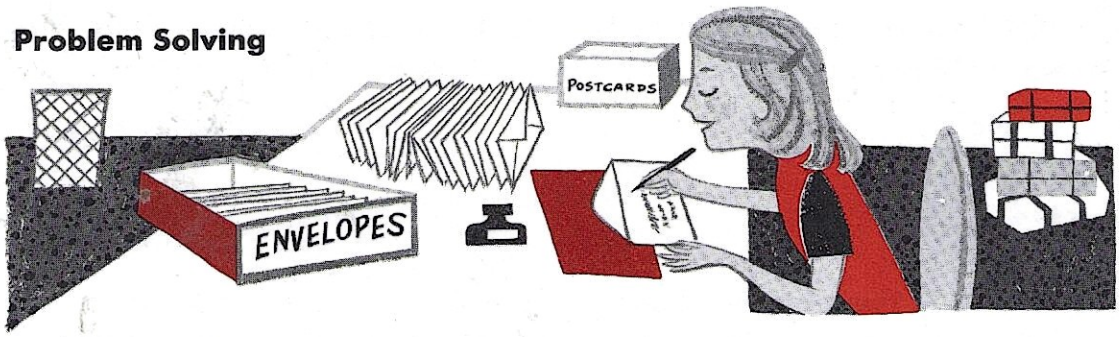
| SUBJECT | EXACT NUMBERS | ROUNDED NUMBERS |
|---|---|---|
| History | 484 | 500 |
| Language | 816 | 800 |
| Arithmetic | 637 | 600 |
| Science | 570 | 600 |

2. Of the 813 children enrolled in Cox School, 392 are girls. About how many boys are there? Round to the nearest hundred.

*Round to the nearest hundreds before working these examples.*

| | | | | |
|---|---|---|---|---|
| 3. | 567<br>645<br>289<br>+843 | 489<br>938<br>273<br>+569 | 845<br>666<br>387<br>+530 | 669<br>532<br>926<br>+469 |
| 4. | 495<br>+305 | 847<br>+875 | 496<br>+716 | 240<br>+387 |
| 5. | 1432<br>−824 | 967<br>−673 | 1639<br>−794 | 742<br>−238 |
| 6. | 1184<br>−675 | 513<br>−326 | 1357<br>−968 | 689<br>−490 |
| 7. | 1247<br>−335 | 629<br>−232 | 1879<br>−184 | 327<br>−115 |

## Problem Solving




Use rounded numbers to estimate what a sensible answer would be, before you write anything. Then solve the problems for the exact answers. Check your answers.

1. Janet addressed 63 pieces of mail in the morning. She addressed 21 postcards, 18 letters, and 11 packages in the afternoon. How many pieces of mail did she address in the afternoon? How many pieces did she address in the whole day?

2. Mr. Adams had $325. He paid $56 for a suit, $17 for shirts, $8 for shoes, and $6 for a hat. How much did he spend? How much did he have left?

3. Hams are $.63 a pound. The grocer bought one that weighed 10 pounds, one that weighed 12 pounds, and one that weighed 16 pounds. What was the total weight of the three hams? What was the total cost of the three hams?

4. Tom weighs 103 pounds, Dick weighs 107 pounds, and Harry weighs 108 pounds. What is the total weight of the three boys? What is their average weight?

5. Mr. Peters paid $10 for a box of 128 pears. He found that 15 of them were too ripe to sell. He sold the others at 10¢ each. How much did he get for the pears he sold? What was his profit?

6. Mrs. Davis bought 4 dozen eggs at 53¢ a dozen, and a pound of butter for 78¢. How much did the eggs cost? What was the cost of the eggs and butter together?

7. Mr. Carr bought 7 shirts at $2.75 each. He gave the clerk a 20-dollar bill. How much did the shirts cost? How much change did he get back?

8. Jerry had 342 rabbits. He sold one third of them at $1.10 each. How many rabbits did he sell? How much did he get for the rabbits he sold?

9. Miss Robertson bought 225 oranges. She kept 9 for herself. She divided the remainder equally among the 36 children in her room. How many oranges did each child get?

10. The Hall twins raised 36 chickens, and sold them at $.90 each. They divided the money equally. How much did each get?

11. Cheese is $.72 a pound. Jack bought a quarter pound. He gave the clerk $1. How much change should Jack get back?

12. Helen is a salesgirl. She is paid $4 per day, plus $\frac{1}{10}$ of the amount of her sales. What is her pay for a day when her sales are $50?

13. Find the cost of 6 pairs of socks at 65¢ a pair and 1 pair of shoes at $9.75.

14. Mr. Harris earns $375 a month. His rent costs $90, food costs $85, and clothing costs $35. How much does he have left after paying for rent, food, and clothes?

15. The airline distance from Los Angeles to New York is 2624 miles. If a plane made the trip in 8 hours, what was its speed?

16. It is about 4550 miles from St. Louis to Berlin, Germany. At an average speed of 350 miles per hour, how long will it take a plane to make the trip?

17. A lunchroom sold milk for 6¢ a half pint. What will it cost to provide one bottle for each child in a class of 27 children?

▶ Some necessary facts are missing in the following problems. What facts are needed before you can solve the problems? Supply sensible facts and solve.

18. How much will doughnuts for a party cost?

19. Allow three cookies per person. What is the cost of enough cookies for the party?

20. How many steps are in one mile? In two miles?

21. What is the cost of two dozen eggs and a pound of butter?

22. How many quarts of ice cream are needed for the party?

23. What is the cost of material for a dress?

24. Marie missed six problems. How many did she get right?

25. What is the distance around your classroom?

26. John read $\frac{1}{4}$ of the book. How many pages did he read?

27. Bob bought a bat and a ball. How much change did he get back?

## Improving Your Multiplication

Jane wanted to work in the library. An important part of the work is keeping records correctly. To find out if Jane was good enough in arithmetic, the librarian gave her this problem as a test.

Pupils withdraw an average of 312 books a week. How many books do they withdraw in 36 weeks?

312 multiplicand
×36 multiplier
1872 } partial products
936 }
11,232 product

These are the keys to success in multiplying.

1. **Know the basic multiplication facts.**
2. **Know how to use 1-figure multipliers and how to carry.**
3. **Know how to use 2-figure multipliers.**
4. **Know how to use 3-figure multipliers.**
5. **Know how to check.**

1 The first key to success in multiplication is knowing the facts.

■ **The basic multiplication facts are all the multiplications in which a 1-figure number is multiplied by a 1-figure number.**

*Find the products.*

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | 8 | 9 | 7 | 5 | 6 | 5 |
| | ×8 | ×7 | ×6 | ×7 | ×8 | ×9 |
| 2. | 7 | 9 | 9 | 3 | 6 | 6 |
| | ×4 | ×6 | ×8 | ×9 | ×4 | ×7 |
| 3. | 8 | 4 | 7 | 3 | 4 | 7 |
| | ×7 | ×8 | ×7 | ×7 | ×9 | ×8 |
| 4. | 8 | 6 | 4 | 9 | 5 | 8 |
| | ×9 | ×6 | ×7 | ×9 | ×8 | ×6 |
| 5. | 7 | 3 | 5 | 6 | 8 | 4 |
| | ×9 | ×8 | ×6 | ×9 | ×5 | ×6 |

*Give rules or an easy way to find the products in the following examples.*

6. Any number × 0 = ■
7. Any number × 1 = ■
8. Any number × 2 = ■
9. Any number × 5 = ■

*Review all the basic multiplication facts. They are given on page 298.*

2 It is important to know how to use a 1-figure multiplier and how to carry.

Look at example 10. You begin the first one by saying 3×6=18. Remember that when you write the 8 and carry the 1 you are really carrying 1 ten.

10. Do the following examples aloud. Explain each step in carrying.

| 76 | 47 | 247 | 388 |
|---|---|---|---|
| ×3 | ×2 | ×2 | ×4 |

*Multiply. Work carefully.*

| | | | | |
|---|---|---|---|---|
| 11. | 564 | 397 | 678 | 507 |
| | ×2 | ×3 | ×4 | ×5 |
| 12. | 489 | 736 | 577 | 938 |
| | ×6 | ×7 | ×8 | ×9 |
| 13. | 781 | 572 | 708 | 649 |
| | ×2 | ×3 | ×4 | ×5 |
| 14. | 367 | 598 | 736 | 874 |
| | ×6 | ×7 | ×8 | ×9 |

**3** With 2-figure multipliers, you multiply by tens the same as you multiply by ones.

$3 \times 46 = 138$ $30 \times 46 = 1380$

A short-cut way to multiply by 30 is to multiply by 3 and annex a 0. To annex a 0 means to write a 0 after the number.

*Study this multiplication.*

| Think this: | Do this: |
|---|---|
| 46 | 46 |
| ×32 | ×32 |
| 92 = 2×46 | 92 |
| 1380 = 30×46 | 138 |
| 1472 = 32×46 | 1472 |

*Notice that the following examples have 2-figure multipliers. Copy and multiply.*

| | | | | |
|---|---|---|---|---|
| 15. | 82 | 34 | 769 | 158 |
| | ×36 | ×43 | ×24 | ×53 |
| 16. | 75 | 94 | 318 | 206 |
| | ×83 | ×56 | ×74 | ×67 |
| 17. | 67 | 51 | 842 | 943 |
| | ×57 | ×76 | ×87 | ×93 |
| 18. | 93 | 79 | 947 | 584 |
| | ×49 | ×62 | ×85 | ×84 |

19. Test drivers drove an automobile for 24 hours at an average speed of 67 miles per hour. How many miles was this in all?

20. A farmer estimates that his hogs will gain an average of 42 pounds each in a month. What will be the total gain of 78 hogs?

21. Mr. Lee has 48 hens. If each hen lays an average of 232 eggs per year, how many eggs will his flock lay in a year?

**4** With 3-figure multipliers, you multiply by hundreds the same as you multiply by ones. A short way to multiply by 700 is to multiply by 7 and annex two 0's.

$7 \times 32 = 224$ $700 \times 32 = 22{,}400$

The examples at the top of the next page show how to multiply

with 3-figure multipliers. Explain each step in the work. Why are there only two partial products in example B? Why are there only two in example C?

**A.**

$$\begin{array}{r} 432 \\ \times 722 \\ \hline 864 = 2 \times 432 \\ 8640 = 20 \times 432 \\ 302400 = 700 \times 432 \\ \hline 311{,}904 = 722 \times 432 \end{array}$$

**B.**

$$\begin{array}{r} 432 \\ \times 720 \\ \hline 8640 = 20 \times 432 \\ 302400 = 700 \times 432 \\ \hline 311{,}040 = 720 \times 432 \end{array}$$

**C.**

$$\begin{array}{r} 432 \\ \times 702 \\ \hline 864 = 2 \times 432 \\ 302400 = 700 \times 432 \\ \hline 303{,}264 = 702 \times 432 \end{array}$$

*Copy and multiply.*

| | | | | |
|---|---|---|---|---|
| 1. | 927 × 480 | 351 × 710 | 362 × 590 | 184 × 620 |
| 2. | 595 × 806 | 186 × 509 | 724 × 104 | 637 × 302 |
| 3. | 172 × 842 | 263 × 917 | 953 × 136 | 748 × 523 |
| 4. | 470 × 308 | 809 × 207 | 630 × 340 | 504 × 730 |
| 5. | 632 × 470 | 380 × 508 | 732 × 900 | 470 × 632 |

**5** Checking your work is an important part of multiplication.

*Study each check below.*

EXAMPLE

$$\begin{array}{r} 69 \\ \times 24 \\ \hline 276 \\ 138 \\ \hline 1656 \end{array}$$

FRED'S CHECK

$$\begin{array}{r} 24 \\ \times 69 \\ \hline 216 \\ 144 \\ \hline 1656 \end{array}$$

MARY

$$\begin{array}{r} 69 \\ \times 4 \\ \hline 276 \\ \times 6 \\ \hline 1656 \end{array}$$

HELEN

$$\begin{array}{r} 69 \\ \times 3 \\ \hline 207 \\ \times 8 \\ \hline 1656 \end{array}$$

JANE

Jane covered her work and multiplied again.

Explain why each way is a good check. Where did Mary get the multipliers 4 and 6? Why did Helen multiply by 3 and then by 8? Can you find other ways to check the same example? Which check do you like best? Why?

*Multiply. Use the check that is best for each example.*

| | | | | |
|---|---|---|---|---|
| 6. | 734 × 6 | 84 × 53 | 592 × 28 | 163 × 517 |
| 7. | 170 × 8 | 53 × 26 | 269 × 54 | 481 × 305 |
| 8. | 841 × 5 | 51 × 37 | 369 × 42 | 720 × 680 |
| 9. | 360 × 9 | 27 × 86 | 815 × 56 | 194 × 702 |

## Improving Your Division

Sharon applied for work in the library. The librarian asked her to do this problem as a test.

Children from Lincoln School withdrew a total of 16,536 books last year. How can you find the average number per week? Remember that there are 52 weeks in a whole year.

1. This is the way Sharon worked the problem. Explain each step.

```
          318  <-quotient
divisor-> 52)16536  <-dividend
          156
           93
           52
          416
          416
            0  <-remainder
```

These are the keys to success in dividing.

1. **Know the basic division facts.**
2. **Know how to divide with 1-figure divisors.**
3. **Know how to divide with 2-figure divisors.**
4. **Be watchful for 0's in quotients.**
5. **Know how to check.**

1 It is important to know the basic division facts. They are related to the basic multiplication facts.

| Division Facts | Related Multiplication Facts |
|---|---|
| $56 \div 7 = 8$ | $7 \times 8 = 56$ |
| $56 \div 8 = 7$ | $8 \times 7 = 56$ |

*Say the answers to the division questions in examples 2 - 5.*

▶ Supply the quotients to make basic facts of these division questions. Write the other basic division fact and the multiplication facts that are related to it.

| | | | | |
|---|---|---|---|---|
| 2. | $7\overline{)21}$ | $5\overline{)45}$ | $4\overline{)28}$ | $8\overline{)24}$ |
| 3. | $9\overline{)18}$ | $8\overline{)40}$ | $6\overline{)54}$ | $7\overline{)63}$ |
| 4. | $5\overline{)30}$ | $7\overline{)42}$ | $8\overline{)72}$ | $6\overline{)42}$ |
| 5. | $9\overline{)36}$ | $8\overline{)32}$ | $9\overline{)27}$ | $7\overline{)35}$ |

*Review all the basic division facts on page 299.*

▶ This is a division with a remainder.

```
    8
7)59
  56
   3r
```

*Find the quotients and remainders.*

| | | | | |
|---|---|---|---|---|
| 6. | $5\overline{)43}$ | $4\overline{)35}$ | $9\overline{)56}$ | $6\overline{)38}$ |
| 7. | $3\overline{)23}$ | $2\overline{)19}$ | $5\overline{)36}$ | $9\overline{)48}$ |
| 8. | $4\overline{)37}$ | $9\overline{)64}$ | $6\overline{)50}$ | $7\overline{)45}$ |
| 9. | $6\overline{)32}$ | $6\overline{)26}$ | $7\overline{)30}$ | $4\overline{)27}$ |
| 10. | $7\overline{)54}$ | $8\overline{)54}$ | $9\overline{)32}$ | $8\overline{)36}$ |

**2** Make certain that you know how to divide with 1-figure divisors.

*Copy and finish.*

1. $7\overline{)392}$ — $56$, $35$
2. $8\overline{)756}$ — $94$, r 4, $72$
3. $6\overline{)472}$ — $7$
4. $9\overline{)574}$ — $6$

*Divide.*

| | | | |
|---|---|---|---|
| 5. | $4\overline{)184}$ | $6\overline{)432}$ | $7\overline{)4599}$ |
| 6. | $3\overline{)477}$ | $7\overline{)728}$ | $8\overline{)2472}$ |
| 7. | $7\overline{)856}$ | $8\overline{)964}$ | $9\overline{)7743}$ |
| 8. | $6\overline{)753}$ | $8\overline{)497}$ | $4\overline{)3825}$ |

**3** Dividing by a 2-figure divisor is like dividing by a 1-figure divisor, except that you are working with 10's instead of 1's.

▶ In example A below, think how many 60's are equal to 360. This is the same as asking how many 6's are equal to 36. In either case, 6 is the quotient figure. The quotient figure is written over the last figure in 360, because you are finding how many times the divisor is contained in 360.

A. $60\overline{)360}$ — $6$, $360$

B. $64\overline{)384}$ — $6$, $384$

▶ In example B, the divisor, 64, equals 6 tens and 4 ones, and the dividend, 384, equals 38 tens and 4 ones. Think how many 60's (6 tens) are equal to 380 (38 tens), or how many 6's there are in 38. Since you are finding how many times the divisor is contained in 384, you must write the quotient figure over the last figure in 384.

*Divide.*

| | | | |
|---|---|---|---|
| 9. | $32\overline{)768}$ | $23\overline{)782}$ | $72\overline{)5976}$ |
| 10. | $43\overline{)903}$ | $22\overline{)946}$ | $32\overline{)2624}$ |
| 11. | $24\overline{)976}$ | $26\overline{)793}$ | $54\overline{)3355}$ |
| 12. | $36\overline{)828}$ | $24\overline{)988}$ | $87\overline{)2784}$ |

▶ In example C, think how many 6's are in 50. You get 8. Multiply: $8 \times 64 = 512$. Since 512 is larger than 500, the quotient figure 8 is too large. Try 7.

C. $64\overline{)500}$ — $8$, $512$; $64\overline{)500}$ — $7$, r 52, $448$

Whenever a quotient figure is too large, try the next smaller figure.

*Divide.*

| | | | |
|---|---|---|---|
| 13. | $24\overline{)687}$ | $33\overline{)259}$ | $46\overline{)8872}$ |
| 14. | $21\overline{)903}$ | $43\overline{)372}$ | $68\overline{)3886}$ |
| 15. | $43\overline{)946}$ | $57\overline{)413}$ | $82\overline{)2624}$ |
| 16. | $74\overline{)652}$ | $88\overline{)493}$ | $53\overline{)4682}$ |

▶ In some divisions you need to try more than two quotient figures to find the correct one.

*Copy and explain each step.*

D.

$$\begin{array}{r} 9 \\ 24\overline{)181} \\ 216 \end{array} \qquad \begin{array}{r} 8 \\ 24\overline{)181} \\ 192 \end{array} \qquad \begin{array}{r} 7 \\ 24\overline{)181} \\ 168 \\ \hline 13 \end{array}$$

*Divide.*

17. $24\overline{)165}$ $23\overline{)182}$ $34\overline{)2714}$

18. $26\overline{)192}$ $37\overline{)246}$ $29\overline{)1717}$

19. $16\overline{)845}$ $15\overline{)877}$ $19\overline{)7738}$

20. $14\overline{)427}$ $18\overline{)529}$ $17\overline{)5969}$

4 A 0 must be placed in the quotient if the divisor is larger than the number divided.

▶ In this example, a 0 was placed in the quotient because the divisor, 4, was larger than the 3, which was brought down first.

$$\begin{array}{r} 209 \\ 4\overline{)836} \\ 8 \\ \hline 36 \\ 36 \end{array}$$

*Divide.*

21. $6\overline{)4812}$ $9\overline{)6660}$ $32\overline{)16288}$

22. $8\overline{)4830}$ $7\overline{)4245}$ $36\overline{)10944}$

23. $7\overline{)3532}$ $9\overline{)2888}$ $43\overline{)25890}$

24. $5\overline{)1548}$ $7\overline{)1825}$ $67\overline{)38190}$

25. A farmer sold 41 hogs. The total weight was 12,505 pounds. What was the average weight?

5 Knowing how to check is an important part of division.

■ **When there is no remainder, as in example A below, the product of the divisor times the quotient equals the dividend.**

A.

$$\begin{array}{r} 12 \\ 8\overline{)96} \\ 8 \\ \hline 16 \\ 16 \\ \hline \end{array} \qquad \begin{array}{l} \rightarrow 12 \\ \times 8 \\ \hline 96 \end{array}$$

B.

$$\begin{array}{r} 12, \text{ r } 2 \\ 8\overline{)98} \\ 8 \\ \hline 18 \\ 16 \\ \hline 2 \end{array} \qquad \begin{array}{l} \rightarrow 12 \\ \times 8 \\ \hline 96 \\ +2 \\ \hline 98 \end{array}$$

■ **When there is a remainder, as in example B, the product of the divisor times the quotient plus the remainder equals the dividend.**

*Divide and check. Be able to explain each step.*

26. $9\overline{)846}$ $6\overline{)532}$ $52\overline{)24968}$

27. $8\overline{)765}$ $7\overline{)469}$ $64\overline{)44992}$

28. $6\overline{)439}$ $9\overline{)648}$ $37\overline{)2394}$

29. $8\overline{)675}$ $7\overline{)892}$ $43\overline{)7339}$

30. $9\overline{)568}$ $8\overline{)993}$ $56\overline{)8465}$

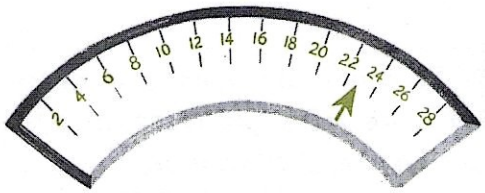
31. $7\overline{)486}$ $6\overline{)569}$ $74\overline{)6758}$

32. A bushel of shelled corn weighs 56 pounds. How many bushels are in a load of corn weighing 9856 lb.?

33. A butcher paid $38.64 for a quarter of beef that weighed 92 lb. What was the cost per pound?

## How Well Have You Learned?

Show how well you understand the work of this unit by doing these examples. Push the pointer as far to the right as you can.




1. Write with our figures.

XLIV LXVI CCLXX MDC

2. Write with Roman numerals.

14 36 46 465

3. Round to nearest hundred.

493 229 749 950

4. Copy the two words from each set that belong together.

a. Addends; quotient; sum
b. Minuend; product; remainder
c. Divisor; product; quotient
d. Approximate; round; Roman
e. Minuend; multiplier; product
f. Division; minuend; quotient
g. Carry; divisor; sum
h. Product; quotient; remainder

*Follow the signs.*

| | | | | |
|---|---|---|---|---|
| 5. | 28 | 863 | 4744 | 873 |
| | 36 | 101 | 2365 | 1138 |
| | 27 | 16 | 206 | 459 |
| | 43 | 84 | 5889 | 95 |
| | +92 | +998 | +3608 | +349 |
| 6. | 16 | 870 | 5487 | 6093 |
| | 8 | 139 | 1004 | 3306 |
| | 30 | 112 | 88 | 1966 |
| | 9 | 343 | 900 | 1517 |
| | +18 | +512 | +1728 | +5604 |

| | | |
|---|---|---|
| 7. | 756 − 183 | 9215 − 4666 |
| 8. | 903 − 655 | 8010 − 3592 |
| 9. | 731 − 85 | 1862 − 994 |
| 10. | 603 − 540 | 1932 − 750 |
| 11. | 600 − 79 | 2001 − 305 |
| 12. | 832 − 84 | 7123 − 2317 |
| 13. | 200 − 135 | 6011 − 5056 |
| 14. | 881 − 177 | 3101 − 867 |
| 15. | 8 × 327 | 29 × 46 |
| 16. | 57 × 542 | 936 × 213 |
| 17. | 728 × 503 | 70 × 60 |
| 18. | 364 × 250 | 820 × 600 |
| 19. | 562 × 40 | 87 × 63 |
| 20. | 305 × 560 | 905 × 640 |
| 21. | 402 × 204 | 720 × 270 |
| 22. | 91 × 112 | 146 × 32 |
| 23. | 58 ÷ 7 | 1107 ÷ 9 |
| 24. | 2436 ÷ 42 | 63 ÷ 8 |
| 25. | 3012 ÷ 6 | 5481 ÷ 63 |
| 26. | 56 ÷ 6 | 1527 ÷ 4 |
| 27. | 5684 ÷ 28 | 164 ÷ 9 |
| 28. | 1685 ÷ 7 | 5796 ÷ 18 |

## Help Yourself to Improve

How well did you do the examples on the previous page? Use this page to correct your weak points. The numbers in color tell you the pages in this unit where the work can be reviewed.

1. Copy. Use commas to mark off into periods. (5)

57634981 187695804325

*Write with figures only. Mark off into periods.* (5)

2. 62 thousand 4 hundred
3. 225 million 75 thousand
4. 87 billion 328 thousand
5. Round to the nearest 10. (6)

64 75 307 2091

6. Round to the nearest 100. (6)

562 350 837

7. Round to the nearest 1000 (6)

68,198 145,512 29,500

*Write these 2-figure numbers with Roman numerals. How many numerals are needed for each?* (2, 3)

8. 18 24 33 84 11
9. 47 88 98 50 69

*Write with our figures.*

10. CDLIX MDCLVII
11. CCLXXI MDCLXVI
12. MCMLIX MMMCDXXXVI

13. You need 12 Roman numerals to write a certain 3-figure number. What is the number?

14. Write with Roman numerals.

1111 555

*Follow the signs.* (9, 12); (16, 17, 18); (20, 21)

15.

| | | | |
|---|---|---|---|
| 538 | | | |
| 247 | | | |
| 93 | 6539 | | |
| 889 | 4067 | | |
| 506 | 29 | 7031 | 659 |
| +18 | +846 | −854 | −470 |

16.

| | | | |
|---|---|---|---|
| 592 | 384 | 480 | 857 |
| ×6 | ×47 | ×205 | ×369 |

17. $6\overline{)4491}$ $9\overline{)2765}$ $72\overline{)3096}$

$24\overline{)4900}$ $56\overline{)3693}$ $14\overline{)2686}$

18. Define each of these terms. Give an example of each of the terms.

| | |
|---|---|
| Addend | Multiplication fact |
| Addition fact | Partial product |
| Ones | Dividend |
| Subtrahend | Quotient |
| Difference | Division facts |
| Subtraction fact | Remainder |
| Tens | Hundreds |
| Thousands | Millions |
| Multiplicand | Period |

## Show That You Know

Write the numbers 1-19 in a column. If one of the three numbers after an example is the correct answer, write that number on your answer sheet after the number of the example. If none of the three numbers is the correct answer, write "None" after the number of the example.

1. Write two hundred twenty with figures.
   20020 202 220 None

2. Write LIX with our figures.
   109 59 509 None

3. Write D with our figures.
   50 500 1000 None

4. Which number is largest?
   DCCC 844 CM

5. The subtrahend is 32 and the remainder is 25. What is the minuend?
   7 57 800 None

*Choose the correct answer from the numbers at the right of each example.*

6. $328 + 177$
   405 495 505 None

7. $22.16 + 71.28 + 5.19$
   98.63 $98.53 $98.63 None

8. $409 + 137$
   536 546 272 None

9. $671 - 146$
   535 525 817 None

10. $502 - 123$
    625 429 379 None

11. $32 \times 8$
    24 40 160 None

12. $241 \times 20$
    261 482 4820 None

13. $5\overline{)515}$
    13 130 103 None

14. $20\overline{)800}$
    2 20 200 None

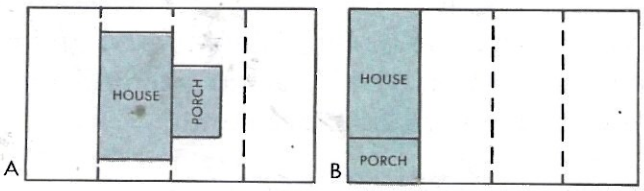
15. $5029 - 2356$
    2663 2773 2673 None

16. $128 \times 4$
    124 32 132 None

17. $35\overline{)805}$
    22 23 24 None

18. $8\overline{)3224}$
    43 403 430 None

19. $625 \times 40$
    2500 25,000 1250 None



## Moving into Fractions

▶ Picture A shows Earl Brown's house and lot. Earl wanted to know how much of the lot was grass that he would have to mow. He imagined how the lot would look if the house and porch were moved to one end.

In his mind Earl divided the lot into four equal parts, as in B. The house and porch took up one part, or $\frac{1}{4}$ of the lot, and the lawn took up three parts, or $\frac{3}{4}$ of the lot.

■ **Numbers like $\frac{1}{4}$ and $\frac{3}{4}$ are called fractions.**

1. In the fraction $\frac{3}{4}$, what does the 4 tell? What does the 3 tell?

2. In the fraction $\frac{1}{4}$, what does the 4 tell? What does the 1 tell?

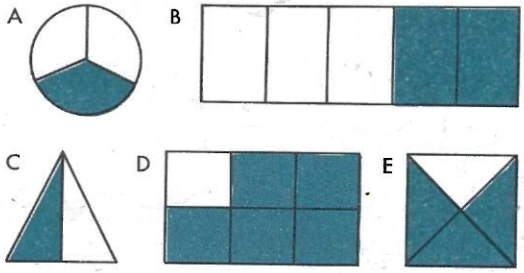
3. In the fraction $\frac{7}{8}$, what does the 8 tell? What does the 7 tell?

▶ The numbers that make a fraction are called *terms*. Each term has a name:

$\frac{3}{4}$ Numerator
Denominator

■ **The denominator of a fraction shows the number of equal parts into which the whole has been divided.**

■ **The numerator of a fraction shows the number of parts taken.**




4. Which drawing shows $\frac{1}{3}$?

5. Which drawing shows $\frac{2}{5}$?

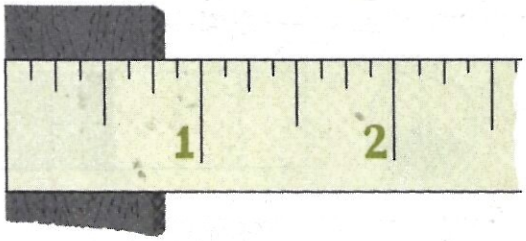
6. What fractions do the other drawings show?

7. The corners of this garden are planted in flowers. The rest of it is grass. Estimate what part of the garden is planted in flowers. Make a drawing to show how you moved the pieces to make your estimate.

## Equivalent Fractions

While making a model airplane, Bob had a strip of wood $\frac{3}{4}$ inch wide that he wanted to cut into two equal parts. How wide will each part be?

Each inch on the ruler that Bob used was divided into 8 equal parts. He saw that each space was $\frac{1}{8}$ inch. The longer marks on his ruler divided each inch into 4 equal parts. What fraction was each of these parts?

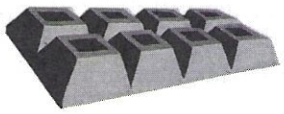



When he measured the strip of wood, Bob saw that $\frac{3}{4}$ inch is equal to $\frac{6}{8}$ inch. If he cut the strip of wood into two equal parts, each part would be one half of $\frac{6}{8}$, or $\frac{3}{8}$ inch wide.

■ **Two fractions that are different in form and equal in value are called equivalent fractions.**

1. Are $\frac{3}{4}$ and $\frac{6}{8}$ equivalent fractions?

2. Helen will use $\frac{3}{4}$ bar of chocolate to make two equal batches of candy. What part of a chocolate bar will she use for each batch? Use the picture below to explain what part of the bar she will use for each batch of candy.



*Fold paper to show that these pairs are equivalent.*

3. $\frac{2}{4} = \frac{1}{2}$ $\quad \frac{4}{8} = \frac{1}{2}$ $\quad \frac{6}{8} = \frac{3}{4}$
4. $\frac{2}{6} = \frac{1}{3}$ $\quad \frac{3}{6} = \frac{1}{2}$ $\quad \frac{4}{6} = \frac{2}{3}$
5. $\frac{4}{12} = \frac{1}{3}$ $\quad \frac{3}{12} = \frac{1}{4}$ $\quad \frac{6}{12} = \frac{1}{2}$
6. $\frac{8}{12} = \frac{2}{3}$ $\quad \frac{9}{12} = \frac{3}{4}$ $\quad \frac{2}{12} = \frac{1}{6}$
7. $\frac{4}{16} = \frac{1}{4}$ $\quad \frac{8}{16} = \frac{1}{2}$ $\quad \frac{12}{16} = \frac{3}{4}$

Bob's ruler shows that $\frac{3}{4}$ and $\frac{6}{8}$ are equivalent fractions. The numerator and denominator are called the *terms* of a fraction. The terms of $\frac{3}{4}$ are smaller numbers than the terms of $\frac{6}{8}$. We say that $\frac{3}{4}$ is in lowest terms.

A fraction is in lowest terms, or in simplest form, when no number except 1 will divide evenly into both terms.

■ **To change a fraction to lowest terms, divide both terms by the largest number that can be divided evenly into both.**

$$\frac{6}{8} = \frac{6 \div 2}{8 \div 2} = \frac{3}{4}$$

*Change to lowest terms.*

8. $\frac{4}{8}$ $\frac{2}{6}$ $\frac{4}{12}$ $\frac{8}{12}$ $\frac{4}{16}$

9. $\frac{2}{8}$ $\frac{3}{6}$ $\frac{3}{12}$ $\frac{9}{12}$ $\frac{8}{16}$

10. $\frac{2}{4}$ $\frac{4}{6}$ $\frac{6}{12}$ $\frac{2}{12}$ $\frac{6}{16}$

11. A pie is cut into sixths. Ann ate $\frac{1}{6}$ and Frank ate $\frac{2}{6}$. How much did they both eat?

1 sixth + 2 sixths = ☒ sixths.

12. Change $\frac{3}{6}$ to lowest terms.

$$\frac{3}{6}=\frac{3\div3}{6\div3}=\frac{1}{2}$$

Prove by drawing a pie and cutting it into sixths.

■ **Fractions with the same denominators are called like fractions.**

■ **To add like fractions,**

**a. Add their numerators.**

**b. Write the sum of the numerators as the new numerator.**

**c. Change the answer to lowest terms.**

$$\frac{1}{6}+\frac{3}{6}=\frac{1+3}{6}=\frac{4}{6}=\frac{2}{3}$$

*Add. Change each answer to lowest terms.*

13. $\frac{5}{8}+\frac{1}{8}$ $\frac{1}{4}+\frac{1}{4}$ $\frac{1}{6}+\frac{2}{6}$ $\frac{2}{9}+\frac{4}{9}$

14. $\frac{1}{10}+\frac{3}{10}$ $\frac{3}{8}+\frac{1}{8}$ $\frac{7}{10}+\frac{1}{10}$ $\frac{4}{12}+\frac{5}{12}$

■ **To subtract like fractions,**

**a. Subtract their numerators.**

**b. Write the difference between the numerators as the new numerator.**

**c. Change the answer to lowest terms.**

$$\frac{5}{8}-\frac{1}{8}=\frac{5-1}{8}=\frac{4}{8}=\frac{1}{2}$$

*Subtract. Change each answer to lowest terms.*

15. $\frac{7}{8}-\frac{3}{8}$ $\frac{5}{6}-\frac{1}{6}$ $\frac{15}{16}-\frac{3}{16}$ $\frac{7}{10}-\frac{3}{10}$

16. $\frac{5}{12}-\frac{1}{12}$ $\frac{3}{4}-\frac{1}{4}$ $\frac{9}{10}-\frac{7}{10}$ $\frac{5}{8}-\frac{3}{8}$

■ **Fractions with different denominators are called unlike fractions.**

17. Study this example. What was done before these fractions could be added?

$$\frac{1}{4}=\frac{1\times2}{4\times2}=\frac{2}{8}$$

$$+\frac{3}{8} \qquad +\frac{3}{8}$$

$$\frac{5}{8}$$

*Add. Change to lowest terms. Prove row 18 with drawings.*

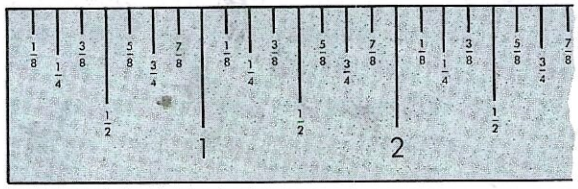
18. $\frac{1}{6}+\frac{1}{3}$ $\frac{1}{6}+\frac{1}{2}$ $\frac{1}{8}+\frac{1}{2}$

19. $\frac{1}{2}+\frac{1}{4}$ $\frac{1}{12}+\frac{3}{4}$ $\frac{1}{4}+\frac{5}{8}$

20. $\frac{7}{15}+\frac{1}{3}$ $\frac{1}{12}+\frac{2}{3}$ $\frac{1}{6}+\frac{5}{12}$

21. $\frac{4}{5}+\frac{1}{10}$ $\frac{1}{6}+\frac{2}{3}$ $\frac{2}{3}+\frac{1}{12}$

## A Ruler as a Help in Learning Fractions




A _____

B _____

C _____

D _____

E _____

F _____

G _____

H _____

1. Into how many parts is each inch on the ruler in the picture divided? What fraction of an inch is each of the smallest spaces?

2. What fraction of an inch is each space between the longer lines?

3. If you do not have a ruler, you can make one very easily. Hold the edge of a sheet of paper along the edge of the ruler in the picture above and mark off the inches and fractions of inches.

Hold your ruler along line A above.

How many $\frac{1}{4}$-inch spaces long is the line? How many $\frac{1}{8}$-inch spaces?

Both $\frac{3}{4}$ in. and $\frac{6}{8}$ in. are measures of the same length. The fractions $\frac{3}{4}$ and $\frac{6}{8}$ are equivalent fractions.

$$\frac{6}{8}=\frac{6\div 2}{8\div 2}=\frac{3}{4} \qquad \frac{3}{4}=\frac{3\times 2}{4\times 2}=\frac{6}{8}$$

It is simpler to say that a line is $\frac{3}{4}$ inch long than to say that it is $\frac{6}{8}$ inch long. Why?

4. Hold your ruler along line B. How many $\frac{1}{8}$-inch spaces long is the line? Is this more or less than 1 inch? How much more or less?

It is simpler to say that a line is $1\frac{1}{8}$ inches long than to say that it is $\frac{9}{8}$ inches long. Why?

5. Measure line C. Count the number of $\frac{1}{8}$-inch spaces; of $\frac{1}{4}$-inch spaces; of $\frac{1}{2}$-inch spaces. What is the simplest measure of line C?

6. Measure each of the other lines above. Write the simplest measure of each line.

7. Which lines were less than 1 inch long? Write the fractions again. The numerator of each of these fractions is less than its denominator. These fractions are called proper fractions.

**A proper fraction is a fraction that is smaller than 1. Its numerator is smaller than its denominator.**

8. Some of the lines measured 1 inch or more. You found such fractions as $\frac{9}{8}$, $\frac{8}{8}$, $\frac{7}{4}$, and $\frac{9}{4}$. These fractions are called improper frac-

tions. How do they differ from proper fractions?

■ **An improper fraction is equal to or greater than 1. Its numerator is equal to or greater than its denominator.**

▶ Which of the following are proper fractions? Which are improper fractions?

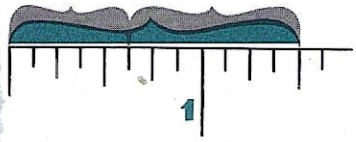
9. $\frac{3}{2}$ $\frac{3}{4}$ $\frac{5}{6}$ $\frac{5}{4}$ $\frac{5}{5}$

10. $\frac{3}{8}$ $\frac{7}{8}$ $\frac{8}{8}$ $\frac{9}{8}$ $\frac{4}{4}$

11. Explain how you can use the ruler to check this addition.

$$\begin{array}{r} \frac{5}{8} \\ +\ \frac{7}{8} \\ \hline \end{array}$$

$\frac{12}{8} = 1\frac{4}{8} = 1\frac{1}{2}$




▶ An improper fraction like $\frac{12}{8}$ is changed to its simplest form by taking the whole number ($\frac{8}{8}$ or 1) out and changing the remaining fraction ($\frac{4}{8}$) to lowest terms ($\frac{1}{2}$). The simplest form of $\frac{12}{8}$ is $1\frac{1}{2}$. A number like $1\frac{1}{2}$ is called a *mixed number.*

■ **A mixed number is made up of a whole number and a fraction.**

*Add. Find answers in simplest form. Check with a drawing.*

12. $\begin{array}{r} \frac{3}{4} \\ +\frac{3}{4} \\ \hline \end{array}$ $\begin{array}{r} \frac{4}{8} \\ +\frac{7}{8} \\ \hline \end{array}$ $\begin{array}{r} \frac{3}{8} \\ +\frac{7}{8} \\ \hline \end{array}$ $\begin{array}{r} \frac{3}{10} \\ +\frac{9}{10} \\ \hline \end{array}$

13. $\begin{array}{r} \frac{2}{3} \\ +\frac{2}{3} \\ \hline \end{array}$ $\begin{array}{r} \frac{3}{4} \\ +\frac{1}{4} \\ \hline \end{array}$ $\begin{array}{r} \frac{5}{6} \\ +\frac{5}{6} \\ \hline \end{array}$ $\begin{array}{r} \frac{3}{7} \\ +\frac{4}{7} \\ \hline \end{array}$

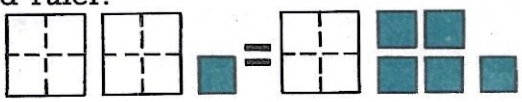
▶ Sue added fraction examples and got the sums below. Change each sum to simplest form. Prove with a ruler.

14. $\frac{2}{2}$ $\frac{8}{4}$ $\frac{6}{2}$ $\frac{8}{8}$ $\frac{16}{8}$

15. $\frac{3}{2}$ $\frac{5}{4}$ $\frac{6}{4}$ $\frac{9}{4}$ $\frac{25}{8}$

16. $\frac{4}{2}$ $\frac{5}{2}$ $\frac{7}{4}$ $\frac{9}{8}$ $\frac{20}{8}$

17. What does this drawing show? Show the same thing with a ruler.



18. Check this subtraction with a ruler.

$$\begin{array}{r} 2\frac{1}{4} = 1\frac{5}{4} \\ -1\frac{3}{4} = -1\frac{3}{4} \\ \hline \frac{2}{4} = \frac{1}{2} \end{array}$$

19. Show with a ruler that 6 equals $5\frac{4}{4}$.

20. Check this subtraction with a ruler.

$$\begin{array}{r} 6 = 5\frac{4}{4} \\ -2\frac{1}{4} = -2\frac{1}{4} \\ \hline 3\frac{3}{4} \end{array}$$

*Copy. Write the missing numerators.*

21. $1 = \frac{?}{4}$ $1\frac{3}{4} = \frac{?}{4}$ $6\frac{1}{4} = 5\frac{?}{4}$

22. $1 = \frac{?}{8}$ $1\frac{5}{8} = \frac{?}{8}$ $3\frac{1}{8} = 2\frac{?}{8}$

23. $1 = \frac{?}{2}$ $1\frac{1}{2} = \frac{?}{2}$ $7\frac{1}{2} = 6\frac{?}{2}$

24. $1 = \frac{?}{3}$ $1\frac{2}{3} = \frac{?}{3}$ $8\frac{1}{3} = 7\frac{?}{3}$

25. $1 = \frac{?}{6}$ $1\frac{1}{6} = \frac{?}{6}$ $4\frac{5}{6} = 3\frac{?}{6}$

## Adding and Subtracting Like Fractions

Gary and Helen use silver wire in making jewelry.

1. One piece of wire is $1\frac{3}{8}$ in. long. Another piece is $1\frac{7}{8}$ in. long. What is the sum of the two lengths?

$$\begin{array}{r} 1\ \frac{3}{8} \\ 1\ \frac{7}{8} \\ \hline 2\frac{10}{8} = 3\frac{2}{8} = \blacksquare \end{array}$$

*Add. Write each answer in simplest form.*

2. $\frac{3}{4}$ + $\frac{2}{4}$ = ; $2\frac{7}{8}$ + $1\frac{5}{8}$ = ; $14\frac{5}{6}$ + $12\frac{3}{6}$ = ; $6\frac{1}{4}$ + $1\frac{3}{4}$ =

3. $\frac{7}{8}$ + $\frac{5}{8}$ = ; $3\frac{3}{4}$ + $6\frac{1}{4}$ = ; $32\frac{3}{8}$ + $9\frac{7}{8}$ = ; $1\frac{5}{8}$ + $2\frac{3}{8}$ =

4. $\frac{5}{6}$ + $\frac{4}{6}$ = ; $1\frac{2}{3}$ + $4\frac{2}{3}$ = ; $40\frac{3}{4}$ + $\frac{3}{4}$ = ; $\frac{5}{6}$ + $3\frac{1}{6}$ =

5. $\frac{7}{8}$ + $\frac{7}{8}$ = ; $2\frac{5}{6}$ + $3\frac{5}{6}$ = ; $18\frac{5}{8}$ + $8\frac{5}{8}$ = ; $9$ + $2\frac{3}{8}$ =

6. A piece of silver wire was $4\frac{1}{8}$ inches long. Helen cut off $1\frac{5}{8}$ inches. How much was left?

$$\begin{array}{rr} 4\frac{1}{8} = 3 + 1\frac{1}{8} = & 3\frac{9}{8} \\ -1\frac{5}{8} = & 1\frac{5}{8} \\ \hline & 2\frac{4}{8} = \blacksquare \end{array}$$

*Subtract. Write each answer in simplest form.*

7. $8\frac{1}{3}$ − $2\frac{2}{3}$ = ; $6\frac{1}{4}$ − $1\frac{3}{4}$ = ; $7\frac{3}{8}$ − $3\frac{5}{8}$ = ; $9\frac{1}{6}$ − $4\frac{5}{6}$ =

8. $9$ − $3\frac{1}{2}$ = ; $8$ − $2\frac{5}{6}$ = ; $9$ − $2\frac{2}{3}$ = ; $6$ − $1\frac{1}{2}$ =

9. $3\frac{1}{3}$ − $2\frac{2}{3}$ = ; $1\frac{1}{8}$ − $\frac{3}{8}$ = ; $8\frac{1}{6}$ − $3\frac{2}{6}$ = ; $6\frac{5}{8}$ − $1\frac{7}{8}$ =

10. $2\frac{3}{8}$ − $1\frac{7}{8}$ = ; $7$ − $6\frac{1}{3}$ = ; $8\frac{1}{3}$ − $\frac{2}{3}$ = ; $9$ − $\frac{5}{6}$ =

11. A sheet of letter paper is $8\frac{1}{2}$ inches wide and 11 inches long. How much longer is it than it is wide?

12. Ella worked in the yard for 2 hours, studied for $1\frac{3}{4}$ hours, and played the piano for $\frac{3}{4}$ hour. How many hours was this altogether?

13. Marie had $16\frac{1}{4}$ yards of ribbon. She used $3\frac{3}{4}$ yards. How much did she have left?

14. Three big boxes of candy weighed $2\frac{1}{8}$ lb., $2\frac{3}{8}$ lb., and $2\frac{7}{8}$ lb. What was the total weight?

## Adding Unlike Fractions

1. What is the sum of $\frac{3}{10}$ and $\frac{1}{10}$? It is easy to add like fractions because they have the same denominators. We say that they have *common denominators*.

2. Tom spent $\frac{1}{2}$ of his money for a movie and $\frac{1}{3}$ for refreshments. What part did he spend?

We cannot add these fractions as they are because their denominators are not alike. We say that they are *unlike fractions*. Before we can add $\frac{1}{2}$ and $\frac{1}{3}$, we must change them so that they have a common denominator.

■ **To add unlike fractions, change them so that they have a common denominator.**

▶ The common denominator will be the smallest number which can be divided evenly by both denominators. This number in our example is 6. The denominator of $\frac{1}{2}$ (2) is contained in 6 three times. We multiply both terms of $\frac{1}{2}$ by 3.

$$\frac{1\times3}{2\times3}=\frac{3}{6} \qquad \frac{1\times2}{3\times2}=\frac{2}{6}$$

▶ The denominator of $\frac{1}{3}$ (3) is contained in 6 two times. We multiply both terms of $\frac{1}{3}$ by 2. Now it is easy to add $\frac{1}{2}$ and $\frac{1}{3}$ because we have found a common denominator. It is easy to add $\frac{3}{6}$ and $\frac{2}{6}$.

■ **To find the common denominator of two or more unlike fractions,**

**a. Test whether the largest denominator contains each other denominator evenly. If it does, then this is the common denominator.**

**b. If the largest denominator is not the common denominator, multiply it in turn by 2, 3, 4, and so on, until you have the smallest number that does contain each denominator evenly.**

*Find sums in simplest form.*

3. $\frac{1}{2}+\frac{1}{4}$ $\quad \frac{1}{4}+\frac{1}{6}$ $\quad \frac{3}{4}+\frac{7}{8}$ $\quad \frac{1}{6}+\frac{1}{2}$ $\quad \frac{2}{3}+\frac{5}{6}$

4. $\frac{1}{4}+\frac{1}{3}$ $\quad \frac{3}{8}+\frac{5}{12}$ $\quad \frac{3}{10}+\frac{2}{5}$ $\quad \frac{1}{2}+\frac{5}{6}$ $\quad \frac{7}{12}+\frac{5}{8}$

5. $\frac{1}{8}+\frac{5}{6}+\frac{2}{3}$ $\quad \frac{3}{4}+\frac{1}{2}+\frac{1}{3}$ $\quad \frac{5}{8}+\frac{1}{6}+\frac{1}{2}$ $\quad \frac{1}{4}+\frac{1}{3}+\frac{1}{8}$ $\quad \frac{5}{12}+\frac{4}{9}+\frac{2}{3}$

6. $3\frac{1}{2}+2\frac{3}{4}+7\frac{5}{8}$ $\quad 6\frac{2}{3}+7\frac{1}{2}+4\frac{1}{6}$ $\quad 7\frac{3}{10}+8\frac{1}{2}+2\frac{4}{5}$ $\quad 9\frac{3}{8}+2\frac{1}{2}+1\frac{1}{4}$ $\quad 1\frac{3}{10}+3\frac{1}{3}+4\frac{1}{2}$

7. $5\frac{3}{4}+2\frac{5}{6}+3\frac{1}{3}$ $\quad 2\frac{1}{2}+4\frac{1}{6}+6\frac{1}{4}$ $\quad 9\frac{7}{10}+3\frac{3}{4}+8\frac{3}{5}$ $\quad 2\frac{5}{12}+7\frac{3}{8}+4\frac{2}{3}$ $\quad 3\frac{1}{4}+1\frac{3}{8}+4\frac{1}{8}$

## Subtracting Unlike Fractions

1. A piece of paper was $\frac{7}{8}$ inch wide. Ned cut off a strip $\frac{1}{4}$ inch wide. How wide was the part that was left? Draw a picture to check.

■ **To subtract unlike fractions, change them so that they will have a common denominator.**

2. Ann walked $\frac{5}{6}$ mile and Al walked $\frac{3}{8}$ mile. How much farther did Ann walk?

What is the common denominator of $\frac{5}{6}$ and $\frac{3}{8}$?

*Do these subtractions.*

3. $\frac{3}{4} - \frac{1}{8}$ $\quad \frac{7}{8} - \frac{1}{2}$ $\quad \frac{9}{16} - \frac{3}{8}$ $\quad \frac{5}{6} - \frac{1}{3}$ $\quad \frac{1}{2} - \frac{1}{6}$

4. $\frac{2}{3} - \frac{1}{5}$ $\quad \frac{5}{6} - \frac{3}{8}$ $\quad \frac{5}{12} - \frac{1}{8}$ $\quad \frac{7}{8} - \frac{2}{3}$ $\quad \frac{3}{4} - \frac{1}{6}$

5. $\frac{1}{2} - \frac{1}{8}$ $\quad \frac{1}{2} - \frac{1}{3}$ $\quad \frac{1}{2} - \frac{1}{6}$ $\quad \frac{3}{4} - \frac{1}{3}$ $\quad \frac{5}{6} - \frac{1}{4}$

6. Helen had $6\frac{1}{4}$ inches of silver wire. She used $3\frac{7}{8}$ inches. How much of the wire was left?

$$6\tfrac{1}{4} = 6\tfrac{2}{8} = 5\tfrac{10}{8}$$
$$-3\tfrac{7}{8} = -3\tfrac{7}{8} = -3\tfrac{7}{8}$$
$$\underline{\qquad\qquad} \quad \underline{\qquad\qquad} \quad \underline{\qquad\qquad}$$
$$\boxed{?}$$

Draw a picture or use a ruler to check this example.

*Do these subtractions.*

7. $3\frac{1}{4} - 1\frac{5}{8}$ $\quad 7\frac{1}{2} - 3\frac{2}{3}$ $\quad 6\frac{1}{4} - 2\frac{1}{2}$ $\quad 6\frac{3}{4} - 3\frac{7}{8}$

8. $8\frac{1}{6} - 3\frac{1}{3}$ $\quad 9\frac{3}{16} - 2\frac{1}{4}$ $\quad 6\frac{2}{3} - 1\frac{5}{6}$ $\quad 7\frac{1}{2} - 3\frac{3}{4}$

9. Gary had 8 inches of silver wire. He cut off $2\frac{1}{4}$ inches. How much of the wire was left? Prove with a drawing.

$$8 = 7\tfrac{4}{4}$$
$$-2\tfrac{1}{4} = -2\tfrac{1}{4}$$
$$\underline{\qquad\qquad}$$
$$\boxed{?}$$

*Do these subtractions.*

10. $6 - 3\frac{1}{2}$ $\quad 9 - 8\frac{1}{3}$ $\quad 4 - 1\frac{3}{4}$ $\quad 5 - \frac{2}{3}$

11. $8\frac{1}{3} - 5$ $\quad 6\frac{2}{3} - 2\frac{1}{6}$ $\quad 3\frac{3}{4} - \frac{3}{4}$ $\quad 4\frac{1}{6} - 3\frac{1}{3}$

12. $4\frac{1}{2} - 3\frac{1}{2}$ $\quad 4\frac{1}{4} - 3\frac{3}{4}$ $\quad 4\frac{3}{4} - 3\frac{1}{2}$ $\quad 8\frac{1}{3} - 6\frac{2}{3}$

13. $7\frac{1}{2} - 1\frac{5}{8}$ $\quad 3\frac{1}{3} - 2\frac{5}{6}$ $\quad 6\frac{3}{8} - 3\frac{1}{2}$ $\quad 7\frac{1}{12} - \frac{2}{3}$

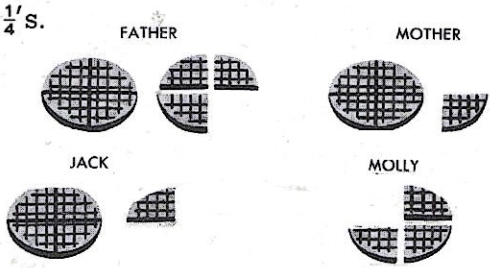
14. $2\frac{1}{2} - \frac{3}{4}$ $\quad 8\frac{1}{6} - 3\frac{5}{8}$ $\quad 7\frac{3}{4} - 2\frac{5}{6}$ $\quad 4\frac{5}{12} - \frac{7}{8}$

15. $7\frac{2}{3} - 2\frac{1}{8}$ $\quad 6\frac{1}{4} - 1\frac{3}{5}$ $\quad 8\frac{1}{5} - 3\frac{1}{3}$ $\quad 9\frac{5}{12} - 2\frac{1}{8}$

## No Pencils, Please

This sign means that you are not to use pencils except to write answers.

The picture below shows how many waffles each member of Jack's family ate one morning. To find the total number, Jack counted by $\frac{1}{4}$'s.




Since there were three whole waffles, Jack began with 3 and then counted the $\frac{1}{4}$'s. He said, "3; $3\frac{1}{4}$, $3\frac{1}{2}$, $3\frac{3}{4}$; 4; $4\frac{1}{4}$; $4\frac{1}{2}$, $4\frac{3}{4}$, 5."

*Write as you count the following. Each number you write must be in simplest form.*

| | Begin with | Count forward by |
|---|---|---|
| 1. | 2 | $\frac{1}{4}$'s to $3\frac{3}{4}$ |
| 2. | 3 | $\frac{1}{2}$'s to $5\frac{1}{2}$ |
| 3. | 4 | $\frac{1}{3}$'s to $6\frac{2}{3}$ |
| 4. | 2 | $\frac{1}{6}$'s to $4\frac{1}{3}$ |
| 5. | 3 | $\frac{1}{8}$'s to $6\frac{1}{4}$ |
| 6. | 2 | $\frac{3}{4}$'s to $5\frac{3}{4}$ |
| 7. | 2 | $\frac{5}{6}$'s to $7\frac{5}{6}$ |
| 8. | 3 | $\frac{3}{8}$'s to $5\frac{5}{8}$ |

Knowing how to count backward by fractions will help you in subtraction of fractions. To count backward from 6 to $4\frac{1}{4}$ by $\frac{1}{4}$'s, write: 6, $5\frac{3}{4}$, $5\frac{1}{2}$, $5\frac{1}{4}$, 5, $4\frac{3}{4}$, $4\frac{1}{2}$, $4\frac{1}{4}$.

*Write as you count the following. Each number you write must be in simplest form.*

| | Begin with | Count backward by |
|---|---|---|
| 9. | 7 | $\frac{1}{4}$'s to $4\frac{3}{4}$ |
| 10. | 9 | $\frac{1}{2}$'s to $5\frac{1}{2}$ |
| 11. | 8 | $\frac{1}{3}$'s to $5\frac{2}{3}$ |
| 12. | 6 | $\frac{1}{6}$'s to $4\frac{1}{3}$ |
| 13. | 9 | $\frac{1}{8}$'s to $7\frac{1}{2}$ |
| 14. | 7 | $\frac{3}{4}$'s to $3\frac{1}{4}$ |
| 15. | 9 | $\frac{5}{6}$'s to $3\frac{1}{6}$ |
| 16. | 6 | $\frac{3}{8}$'s to $2\frac{1}{4}$ |

*Picture in your mind what the example asks. Write only the answers. Tell how many —*

| | | | |
|---|---|---|---|
| 17. | $\frac{1}{4}$'s = 1 | $\frac{1}{3}$'s = 2 | $\frac{1}{5}$'s = 3 |
| 18. | $\frac{1}{2}$'s = 4 | $\frac{1}{4}$'s = 2 | $\frac{1}{6}$'s = $\frac{1}{2}$ |

*Write only the answers.*

| | | | |
|---|---|---|---|
| 19. | $\frac{1}{2} + \frac{1}{4}$ | $\frac{1}{4} + \frac{1}{8}$ | $1\frac{1}{4} + \frac{1}{4}$ |
| 20. | $\frac{3}{4} + \frac{1}{2}$ | $\frac{1}{3} + \frac{1}{6}$ | $1\frac{3}{8} + \frac{3}{8}$ |
| 21. | $\frac{1}{2} - \frac{1}{4}$ | $\frac{3}{4} - \frac{1}{4}$ | $3\frac{1}{3} - \frac{1}{3}$ |
| 22. | $\frac{3}{4} - \frac{1}{2}$ | $\frac{5}{8} - \frac{1}{4}$ | $1\frac{7}{8} - \frac{3}{8}$ |

## Multiplying with Fractions

The class had to buy ribbon to tie six small boxes. One-half yard per box would allow for a small bow. Prettier bows could be made with $\frac{2}{3}$ yard or $\frac{3}{4}$ yard of ribbon per box. The class worked these examples to find out how much ribbon would be needed in all for each size bow.

1. $\frac{6}{1} \times \frac{1}{2} = \frac{6 \times 1}{1 \times 2} = \frac{6}{2} = ?$

CHECK: Count six $\frac{1}{2}$'s. Say $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3.

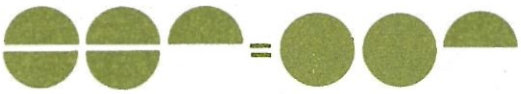
Any whole number may be written as a fraction with denominator 1, as $6 = \frac{6}{1}$. Why?

2. $\frac{6}{1} \times \frac{2}{3} = ?$ CHECK: Count six $\frac{2}{3}$'s.

3. $\frac{6}{1} \times \frac{3}{4} = ?$ CHECK: Count six $\frac{3}{4}$'s.

4. The class decided to buy $\frac{3}{4}$ yard for each box. Other rooms wanted ribbon, too. How many yards would they need for tying 12 boxes? 18 boxes? 30 boxes?

5. What does this drawing show?



Explain why the example below shows the same thing.

$$\frac{5}{1} \times \frac{1}{2} = \frac{5 \times 1}{1 \times 2} = \frac{5}{2} = 2\frac{1}{2}$$

*Write the numbers these drawings show.*

6.

7.

8.

*Multiply. Write each answer in simplest form. Prove with drawings.*

| | | | |
|---|---|---|---|
| 9. | $6 \times \frac{1}{2}$ | $3 \times \frac{1}{2}$ | $7 \times \frac{1}{2}$ |
| 10. | $6 \times \frac{1}{3}$ | $4 \times \frac{2}{3}$ | $7 \times \frac{1}{3}$ |
| 11. | $7 \times \frac{1}{6}$ | $9 \times \frac{1}{6}$ | $8 \times \frac{1}{6}$ |
| 12. | $6 \times \frac{1}{8}$ | $4 \times \frac{3}{8}$ | $2 \times \frac{5}{8}$ |

13. It takes $4\frac{1}{2}$ yards of material to make a costume. How many yards are needed to make 6 costumes? The answer can be found in this way:

$$\begin{array}{r} 4\frac{1}{2} \\ \times 6 \\ \hline 3 = 6 \times \frac{1}{2} \\ 24 = 6 \times 4 \\ \hline 27 \end{array}$$

Many problems like this are easier to work if we change the mixed number to an improper fraction before multiplying. One way to change is like this:

$$4\frac{1}{2} = 4 + \frac{1}{2} = \frac{8}{2} + \frac{1}{2} = \frac{9}{2}$$

*Study and explain this short way of changing a mixed number to an improper fraction.*

$$4\frac{1}{2}=\frac{4\times2+1}{2}=\frac{9}{2}$$

■ **To change a mixed number to an improper fraction, multiply the denominator of the fraction by the whole number. Then add the numerator of the fraction. This will give the numerator of the improper fraction. Use the same denominator.**

*Explain this multiplication.*

$$\frac{6}{1}\times\frac{9}{2}=\frac{54}{2}=27$$

*Change to improper fractions.*

14. $2\frac{1}{2}$ $1\frac{1}{2}$ $3\frac{1}{2}$ $4\frac{1}{2}$ $6\frac{1}{2}$

15. $3\frac{1}{3}$ $1\frac{2}{3}$ $6\frac{2}{3}$ $8\frac{1}{3}$ $4\frac{2}{3}$

16. $2\frac{1}{4}$ $6\frac{1}{4}$ $3\frac{3}{4}$ $4\frac{3}{4}$ $8\frac{1}{4}$

17. $2\frac{1}{6}$ $3\frac{5}{6}$ $3\frac{1}{6}$ $4\frac{5}{6}$ $5\frac{1}{6}$

18. $1\frac{1}{8}$ $2\frac{3}{8}$ $3\frac{5}{8}$ $1\frac{7}{8}$ $3\frac{7}{8}$

*Multiply. Use a different way of multiplying as a check.*

19. $8\times2\frac{1}{2}$ $5\times3\frac{1}{2}$ $4\frac{1}{2}\times10$

20. $6\times1\frac{2}{3}$ $6\frac{2}{3}\times6$ $3\frac{1}{3}\times12$

21. $8\times2\frac{1}{4}$ $4\times3\frac{3}{4}$ $1\frac{3}{4}\times20$

22. $3\times4\frac{1}{6}$ $8\times2\frac{5}{6}$ $1\frac{5}{6}\times15$

23. $4\times3\frac{5}{8}$ $6\times3\frac{7}{8}$ $4\frac{3}{8}\times18$

■ **When multiplying small mixed numbers, change both mixed numbers to improper fractions.**

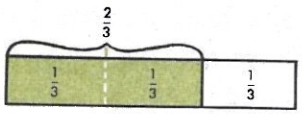
*Multiply.*

24. $1\frac{3}{4}\times2\frac{2}{3}$ $6\frac{2}{3}\times1\frac{7}{8}$ $6\frac{1}{4}\times5\frac{1}{3}$

25. $8\frac{1}{3}\times3\frac{3}{5}$ $4\frac{3}{8}\times3\frac{1}{7}$ $5\frac{5}{6}\times1\frac{4}{5}$

26. Study this multiplication. Explain how the drawing proves it.

$$\frac{1}{2}\times\frac{2}{3}=\frac{2}{6}=\frac{1}{3}$$




*Multiply. Prove with drawings.*

27. $\frac{1}{2}\times\frac{3}{5}$ $\frac{1}{2}\times\frac{4}{5}$ $\frac{1}{3}\times\frac{3}{5}$

28. $\frac{1}{4}\times\frac{2}{3}$ $\frac{3}{4}\times\frac{2}{3}$ $\frac{2}{3}\times\frac{1}{2}$

29. The two multiplications below show two ways of finding the answer in lowest terms. Explain both examples. Dividing before multiplying, as in B, is called *canceling*. Why does canceling make multiplication of fractions easier?

A. $\frac{3}{4}\times\frac{8}{15}=\frac{24}{60}=\frac{2}{5}$ (2, 5)

B. $\frac{3}{4}\times\frac{8}{15}=\frac{2}{5}$ (1, 2, 1, 5)

■ **In the multiplication of fractions, to cancel means to divide a numerator and a denominator by the same number.**

*Multiply. Be sure to cancel.*

30. $\frac{2}{3}\times\frac{5}{8}$ $6\times\frac{3}{8}$ $2\frac{1}{4}\times2\frac{2}{3}$

31. $\frac{3}{4}\times\frac{2}{9}$ $\frac{5}{6}\times4$ $1\frac{7}{8}\times2$

32. $\frac{7}{8}\times\frac{4}{5}$ $\frac{3}{4}\times6$ $8\times1\frac{3}{4}$

## Problems Using Fractions

*Make drawings to help you solve these problems.*

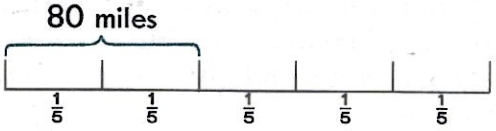
1. Grace had 20 problems to do. How many did she have left when she had worked $\frac{1}{4}$ of them?

2. The regular price of a suit is \$84. The sale price is $\frac{3}{4}$ as much as the regular price. What is the sale price?

3. Hats are on sale at $\frac{2}{3}$ of their regular price of \$9. How much can be saved by buying the hat at the sale price?

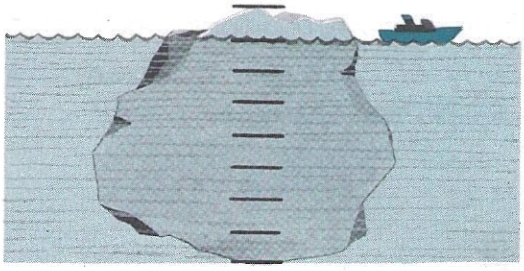
4. The regular price of gloves is \$4. The store advertised a sale with $\frac{1}{5}$ of the price off. What fraction tells what part the sale price is of the regular price? What is the sale price?

5. After driving 80 miles, Mr. Smith figured that he had gone $\frac{2}{5}$ of his whole trip. Use the drawing below to figure how many miles there were in the whole trip.




6. Mr. Carr had to drive 240 miles. How many more miles will he still have to go when he has gone $\frac{1}{4}$ of the way?

7. About $\frac{1}{8}$ of an iceberg is



above water. In the picture above, how many feet are below water if about 40 feet extend above the water?

8. Jim has 18 problems to do. How many had he done when he still had $\frac{1}{3}$ of them to do?

9. Mr. Brown owns $\frac{3}{4}$ acre of land, and $\frac{8}{9}$ of his land is a garden. What fraction of an acre is the garden?

10. A board was 12 feet long. How much is left after $2\frac{3}{4}$ feet have been sawed off?

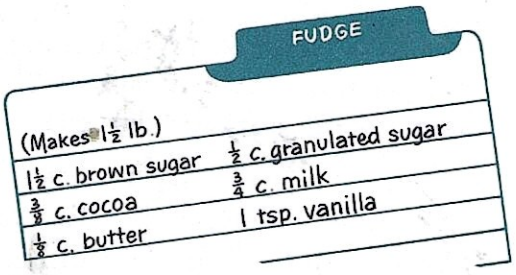
11. Mrs. Hale bought cloth remnants with these lengths: $3\frac{1}{4}$ yd.; $2\frac{2}{3}$ yd.; $1\frac{1}{6}$ yd.; $4\frac{1}{2}$ yd. What was the total length?

12. A dress pattern calls for $3\frac{3}{8}$ yards of material. Will a remnant $2\frac{1}{2}$ yards long and another $\frac{3}{4}$ yard long be as much as $3\frac{3}{8}$ yards?

Find the cost of —

13. $\frac{1}{2}$ lb. of tea at \$1.20 a pound.
14. $1\frac{1}{2}$ lb. of steak at 80¢ per lb.
15. $\frac{1}{4}$ lb. of pepper at \$1.60 per lb.
16. $2\frac{1}{4}$ lb. of ham at 56¢ a pound.

## More Problems Using Fractions




*Estimate an answer that seems sensible before you begin to work each problem.*

1. Mrs. Eddy will send boxes of fudge to 24 of her friends. If each box contains $\frac{3}{4}$ pound of fudge, how many pounds will she send in all?

▶ Mrs. Eddy uses the recipe in the picture above. In the recipe, **c.** stands for **cup** or **cups**, and **tsp.** stands for **teaspoon** or **teaspoons**.

2. How much brown sugar is needed to make 3 pounds of fudge?

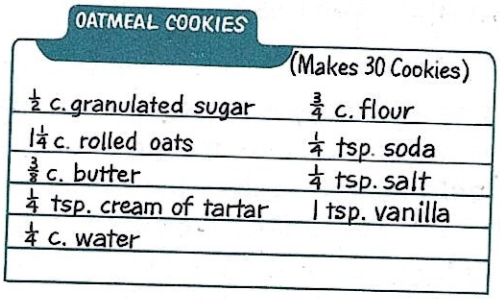
3. How much cocoa is needed to make 6 pounds of fudge?

4. How much milk is needed to make $4\frac{1}{2}$ pounds of fudge?

5. How much butter is needed to make 12 pounds of fudge?

6. How much granulated sugar is needed to make 6 pounds of fudge?

7. Look at the recipe for oatmeal cookies. How much butter is needed to make 120 cookies?




8. How much sugar is needed to make 75 cookies?

9. How much flour is needed to make 90 cookies?

10. How much rolled oats is needed to make 150 cookies?

11. How much soda is needed to make 45 cookies?

▶ Each of these amounts weighs one pound.

$4\frac{1}{2}$ c. cake flour  4 c. cocoa
$2\frac{1}{4}$ c. brown sugar  $2\frac{1}{2}$ c. raisins

12. Cake flour costs 12¢ a pound. What is the cost of 9 cups? Of $1\frac{1}{2}$ cups?

13. What is the weight of $1\frac{1}{4}$ cups of raisins? Of 5 cups?

14. What is the weight of 1 cup of cocoa? Of 2 cups?

15. Brown sugar costs 15¢ a pound. What is the cost of $4\frac{1}{2}$ cups of brown sugar? Of $1\frac{1}{2}$ cups?

16. At 30¢ a pound, what is the cost of 5 cups of raisins?

## Problem Solving

Write the numbers 1 to 16 in a column. Before each number, write the letter that tells the process you would use to solve the problem: A for add; S for subtract; M for multiply; D for divide. Do not solve the problems now. The four numbers below each problem will be used later in solving the problems.

1. What is the cost of $6\frac{1}{4}$ pounds of meat at 48¢ a pound?
   $1 $3 $5 $6

2. A room is 9 feet wide and 12 feet long. What is the distance around the room?
   3 ft. 21 ft. 42 ft. 108 ft.

3. At 78¢ an hour, how much can Tom earn in 38 hours?
   $8 $30 $40 $78

4. Mr. Parks drove 247 miles in 6 hours and 10 minutes. What was his average speed per hour?
   6 mi. 30 mi. 40 mi. 60 mi.

5. Elmer feeds his dog a half pound of meat per day. How much is this for a month?
   5 lb. 15 lb. 30 lb. 60 lb.

6. There were 1764 trees in a park. A storm blew down 294 of them. What part of the trees did the storm blow down?
   $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{6}$

7. There were 72 words on a spelling test. Edward missed 24 of them. What part did he miss?
   $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{8}$

8. Janet weighs 59 lb. Her father weighs 177 lb. Her father is how many times as heavy as Janet?
   2 3 4 5

9. A school has 18 rooms. There is an average of 32 pupils per room. How many pupils are in the school?
   200 300 600 800

10. At 32 miles an hour, how long will it take to drive 600 miles?
    18 hr. 22 hr. 30 hr. 35 hr.

11. Dick had $75. He spent $49.95 for a suit. What part of his money did he spend?
    $\frac{1}{4}$ $\frac{1}{3}$ $\frac{1}{2}$ $\frac{2}{3}$

12. A roast weighs $8\frac{1}{4}$ pounds. What will it cost at 60¢ a pound?
    $3 $5 $6 $8

13. A remnant of material was $7\frac{3}{4}$ yards long. It cost $3.98. What was the price per yard?
    39¢ 50¢ 60¢ 75¢

14. One recipe will make $2\frac{1}{2}$ dozen cookies. How many recipes are needed for 20 dozen cookies?
    4 8 10 20

15. A smoked ham weighs $12\frac{1}{2}$ pounds. What will it cost at 48¢ a pound?

$4 $5 $6 $8

16. Joe weighs 115 pounds. Carol weighs 85 pounds. How much more does Joe weigh than Carol?

20 lb. 30 lb. 200 lb. 215 lb.

▶ Four numbers were written after each of the problems 1-16. Choose the one that is the right answer or nearest to the right answer. Try to figure out the right answer mentally. Rounded numbers can help you. Write the answer you choose after the number of the problem.

**No Pencils, Please**

Do not use your pencil except to write the answers.

*Find the exact answers.*

17. One bus fare is $3.95. How much are six bus fares?

THINK: $3.95 = $4 − 5¢

$6 \times \$3.95 = 6 \times \$4 - 6 \times 5¢$

$\$24 - 30¢ = \$$?

18. Shoes are $7.98 a pair. What is the cost of three pairs?

THINK: $7.98 = $8 − 2¢

$3 \times \$8 - 3 \times 2¢ = $ ?

19. A shirt costs $1.98. Sales tax is 4¢. What is the total cost of a shirt? What is the total cost of five shirts?

$\$1.98 + 4¢ = $ ?

20. What is the cost of five yards of material at $1.19 a yard?

$\$1.19 = \$1.20 - 1¢$

21. What is the cost of four yards of material at $1.23 a yard?

$\$1.23 = \$1.25 - 2¢$

22. What is the cost of six tubes of toothpaste at 59¢ each?

23. What is the cost of 32 pounds of nuts at 25¢ a pound?

$25¢ = \$\frac{1}{4}$ $32 \times \$\frac{1}{4} = $ ?

24. How much can Dorothy earn in 8 hours at 75¢ an hour?

25. One dress cost $7.98. Another cost $5.98. What did they both cost?

26. Jane bought a blouse for $2.79. She gave the clerk $5. How much change should she get?

27. There are 496 bricks in a row. How many bricks are in four rows?

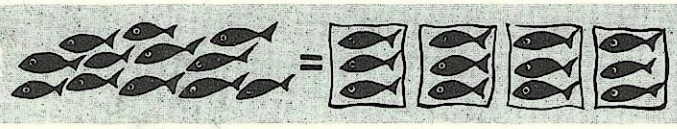
28. Lester worked from 12:30 P.M. till 5 P.M. How many hours was this?

29. How many days is it from August 7 till September 10?

31 − 7 = 24, days left in August.

24 + 10 = ?

## Dividing a Whole Number by a Fraction

A. 

1. Jerry caught 12 fish and gave 3 fish to each of several friends. How many people got some fish? You can find the answer by making a drawing, by subtraction, by addition, or by division. Explain each method.

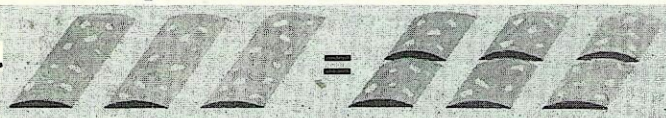
B.
$$\begin{array}{r} 12 \\ -3 \\ \hline 9 \\ -3 \\ \hline 6 \\ -3 \\ \hline 3 \\ -3 \\ \hline 0 \end{array} \begin{array}{l} (1) \\ \\ (2) \\ \\ (3) \\ \\ (4) \end{array}$$

C.
$$\begin{array}{r} 3 \\ +3 \\ \hline 6 \\ +6 \\ \hline 12 \end{array} \begin{array}{l} (1) \\ (2) \\ \\ (3) \text{ and } (4) \end{array}$$

D. $12 \div 3 = 4$

2. Tom had 3 candy bars and gave $\frac{1}{2}$ bar to each of several friends. How many persons received candy? Again, you can find the answer by making a drawing, by addition, or by subtraction. Explain each method.

B.
$$\begin{array}{r} \frac{1}{2} \\ +\frac{1}{2} \\ \hline 1 \\ +1 \\ \hline 2 \\ +1 \\ \hline 3 \end{array} \begin{array}{l} (1) \\ (2) \\ \\ (3) \text{ and } (4) \\ \\ (5) \text{ and } (6) \end{array}$$

A. 

C. (1) (2) (3) (4) (5) (6)

$3-\frac{1}{2}=2\frac{1}{2};\ 2\frac{1}{2}-\frac{1}{2}=2;\ 2-\frac{1}{2}=1\frac{1}{2};\ 1\frac{1}{2}-\frac{1}{2}=1;\ 1-\frac{1}{2}=\frac{1}{2};\ \frac{1}{2}-\frac{1}{2}=0$

3. You can also find the answer to problem 2 by division. Divide the total number of candy bars (3) by the part of a bar that each person received ($\frac{1}{2}$). $3 \div \frac{1}{2} = ?$

THINK: When a candy bar is cut into halves, a whole is divided into 2 equal parts. In three bars there are $3 \times 2 = 6$ equal parts. When 1 part is given to each person, 6 persons will receive candy.

6 halves $\div$ 1 half $= 6$

4. A roll of shelf paper was 3 yards long. Jane used it to line shelves which measured $\frac{3}{4}$ yard each in length. Use a drawing to find how many shelves she could line. Check by addition or subtraction. Then find the answer by division.

THINK: Each yard has 4 fourths. 3 yards equal $3 \times 4 = 12$ fourths. $3 \div \frac{3}{4} = 12$ fourths $\div$ 3 fourths $= ?$

*Divide. Check by another method.*

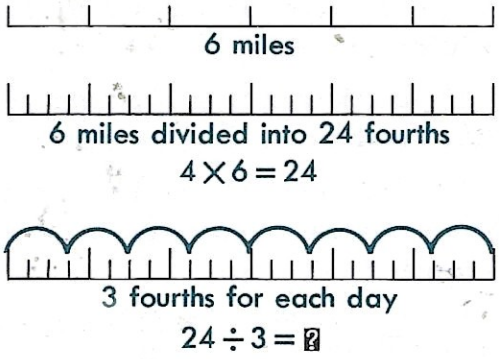
5. $3 \div \frac{1}{2}$ $3 \div \frac{3}{5}$ $4 \div \frac{1}{4}$ $7 \div \frac{1}{3}$

6. $10 \div \frac{2}{3}$ $8 \div \frac{1}{4}$ $6 \div \frac{2}{5}$ $4 \div \frac{2}{3}$

■ **To divide a whole number by a fraction, change the whole number to an improper fraction with the same denominator as the fraction. Then divide the numerators.**

7. A 6-mile section of road needed repairing. If the road repair crew repaired $\frac{3}{4}$ of a mile per day, how many days did it take to repair the road? Find the answer by division and prove by addition or subtraction.

Study the drawing below. It shows how to find the answer by division in another way.




THINK: I multiply the number of miles (6) by the number of fourths in 1 mile (4). Then I divide this number (24) by the number of fourths completed each day (3). Then, $6 \div \frac{3}{4} = 6 \times 4 \div 3$. This can be written as follows:

$$6 \div \tfrac{3}{4} = \tfrac{6}{1} \times \tfrac{4}{3} = \tfrac{24}{3} = ?$$

When the division is written this way, notice what happens to the numerator and the denominator of $\frac{3}{4}$. When a fraction is "turned over" like this, we say that we *invert* the fraction.

Of course, you should cancel if you can. Explain the division.

$$6 \div \tfrac{3}{4} = \tfrac{\overset{2}{6}}{1} \times \tfrac{4}{\underset{1}{3}} = 8$$

■ **To divide by a fraction, invert the fraction and multiply.**

▶ A grocer has 24 pounds of spices which he must put into smaller bags. How many bags can he fill if each bag contains each of these amounts?

| | | | | |
|---|---|---|---|---|
| 8. | 6 lb. | 4 lb. | 3 lb. | 2 lb. |
| 9. | $\frac{1}{2}$ lb. | $\frac{1}{3}$ lb. | $\frac{1}{4}$ lb. | $\frac{1}{8}$ lb. |
| 10. | $\frac{3}{4}$ lb. | $\frac{3}{8}$ lb. | $\frac{2}{3}$ lb. | $\frac{3}{5}$ lb. |

*Divide. Prove with drawings.*

| | | | |
|---|---|---|---|
| 11. | $6 \div \frac{3}{4}$ | $8 \div \frac{3}{4}$ | $10 \div \frac{3}{4}$ |
| 12. | $6 \div \frac{3}{8}$ | $4 \div \frac{7}{8}$ | $10 \div \frac{5}{8}$ |
| 13. | $5 \div \frac{3}{5}$ | $6 \div \frac{2}{5}$ | $10 \div \frac{4}{5}$ |
| 14. | $6 \div \frac{5}{6}$ | $9 \div \frac{3}{6}$ | $10 \div \frac{5}{6}$ |

15. A grocer packed 6 pounds of raisins in $\frac{1}{2}$-pound bags. How many bags did he fill?

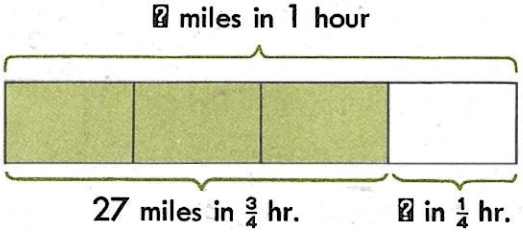
16. Mary had a sheet of paper 3 inches wide which she wanted to cut into strips $\frac{3}{4}$ in. wide. How many $\frac{3}{4}$-in. strips could she cut? $3 \div \frac{3}{4} = ?$

**Problems Using Fractions**

*Drawings will be helpful in solving some of these problems. Estimate what is a sensible answer before you work with a pencil.*

1. Mr. Davis drove 27 miles in $\frac{3}{4}$ hour. At this rate, how far could he drive in 1 hour?

THINK:




2. Mr. Hill drove 30 miles in $\frac{5}{6}$ hour. At this rate, how far could he drive in 1 hour?

3. Mr. Tyler drove 25 miles in $\frac{5}{8}$ hour. Mr. James drove 45 miles in $1\frac{1}{4}$ hours. Which man drove at the faster rate of speed? At these rates, how far could each man drive in 1 hour?

4. Bob earned 75¢ for working $1\frac{1}{4}$ hours. How much was this per hour?

5. Tom paid 90¢ for $1\frac{1}{2}$ pounds of nuts. What was the price per pound?

6. A vinegar bottle holds $\frac{3}{8}$ gallon. How many bottles can be filled from a barrel that holds $31\frac{1}{2}$ gallons?

7. A $1\frac{1}{4}$-pound steak costs 90¢. What is the cost per pound?

8. Mrs. Hart paid 49¢ for $5\frac{1}{4}$ pounds of tomatoes. How much was this per pound?

9. Jerry and Tom hiked $3\frac{3}{4}$ miles in an hour. At this rate, how long would it take them to hike 10 miles?

10. A cubic foot of water is about $7\frac{1}{2}$ gallons. The volume of a tank is 60 cubic feet. How many gallons will the tank hold?

11. Brick cheese is 64¢ a pound. What is the cost of $1\frac{1}{2}$ pounds?

12. Lois paid 72¢ for $\frac{3}{4}$ pound of Swiss cheese. What was the cost per pound?

13. Mr. Smith sold $\frac{3}{4}$ of his apples. He sold 12 bushels. How many bushels did he have left?

14. Mike worked 18 examples in 15 minutes. At that rate, how many examples could he work in 1 hour?

THINK: 15 minutes equals what fraction of an hour?

15. Potatoes are about $\frac{4}{5}$ water. How many pounds of water are in a bushel (60 pounds) of potatoes?

## Fraction Review

*Do what the signs tell you to do.*

| | | | | |
|---|---|---|---|---|
| 1. | $\frac{5}{6}$ $+\frac{7}{8}$ | $\frac{5}{6}$ $+\frac{2}{3}$ | $2\frac{1}{2}$ $+6\frac{1}{4}$ | $13\frac{5}{6}$ $+5\frac{1}{2}$ |
| 2. | $\frac{1}{2}$ $\frac{3}{4}$ $+\frac{5}{8}$ | $\frac{2}{3}$ $\frac{5}{6}$ $+\frac{1}{2}$ | $6\frac{1}{4}$ $2$ $+8\frac{1}{3}$ | $76\frac{3}{8}$ $9\frac{2}{3}$ $+18\frac{3}{4}$ |
| 3. | $\frac{7}{8}$ $-\frac{1}{4}$ | $\frac{5}{6}$ $-\frac{1}{3}$ | $2\frac{1}{4}$ $-2$ | $28\frac{1}{3}$ $-9\frac{1}{2}$ |
| 4. | $\frac{3}{4}$ $-\frac{1}{3}$ | $\frac{7}{8}$ $-\frac{1}{6}$ | $8$ $-6\frac{1}{6}$ | $46\frac{1}{8}$ $-20\frac{3}{4}$ |

*Change to improper fractions.*

| | | | | |
|---|---|---|---|---|
| 5. | $2\frac{1}{4}$ | $6\frac{2}{3}$ | $8\frac{1}{3}$ | $7\frac{1}{2}$ |
| 6. | $3\frac{1}{7}$ | $1\frac{5}{6}$ | $2\frac{2}{3}$ | $1\frac{7}{8}$ |

*Change to whole numbers or mixed numbers in simplest form.*

| | | | | |
|---|---|---|---|---|
| 7. | $\frac{15}{4}$ | $\frac{16}{8}$ | $\frac{12}{8}$ | $\frac{18}{4}$ |
| 8. | $\frac{8}{3}$ | $\frac{11}{6}$ | $\frac{17}{2}$ | $\frac{18}{5}$ |

*Divide.*

| | | | |
|---|---|---|---|
| 9. | $\frac{7}{8} \div \frac{1}{4}$ | $\frac{5}{8} \div 2$ | $2\frac{1}{4} \div 3$ |
| 10. | $\frac{3}{4} \div \frac{1}{3}$ | $\frac{9}{16} \div 3$ | $6\frac{2}{3} \div 4$ |
| 11. | $\frac{15}{16} \div \frac{3}{4}$ | $\frac{8}{15} \div 6$ | $7\frac{1}{2} \div 5$ |
| 12. | $8 \div 3\frac{1}{3}$ | $7 \div \frac{2}{3}$ | $3\frac{1}{3} \div 2\frac{1}{2}$ |
| 13. | $5 \div 1\frac{7}{8}$ | $9 \div \frac{3}{4}$ | $7\frac{1}{2} \div 1\frac{7}{8}$ |
| 14. | $7 \div 1\frac{3}{4}$ | $9 \div \frac{3}{8}$ | $8\frac{1}{3} \div 1\frac{2}{3}$ |

*Choose the best answers.*

**15.** A box holds 60 cubic feet. 1 bu. is about $1\frac{1}{4}$ cubic feet. How many bushels will the box hold?

75 60 48

**16.** Mr. Willis drove 60 miles in $1\frac{1}{3}$ hours. What was his average speed per hour?

45 60 80

**17.** A sheet of copper was $1\frac{1}{2}$ inches wide. Dick cut it into two equal parts. How wide was each?

$3\frac{1}{2}$ in. $1\frac{1}{2}$ in. $\frac{3}{4}$ in.

**18.** A grocer poured $7\frac{1}{2}$ pints of syrup into $\frac{3}{4}$-pint bottles. How many bottles did he fill?

6 10 20

**19.** Mrs. Hill cut $\frac{3}{4}$ pound of cheese into $\frac{1}{16}$-pound pieces. How many pieces did she have?

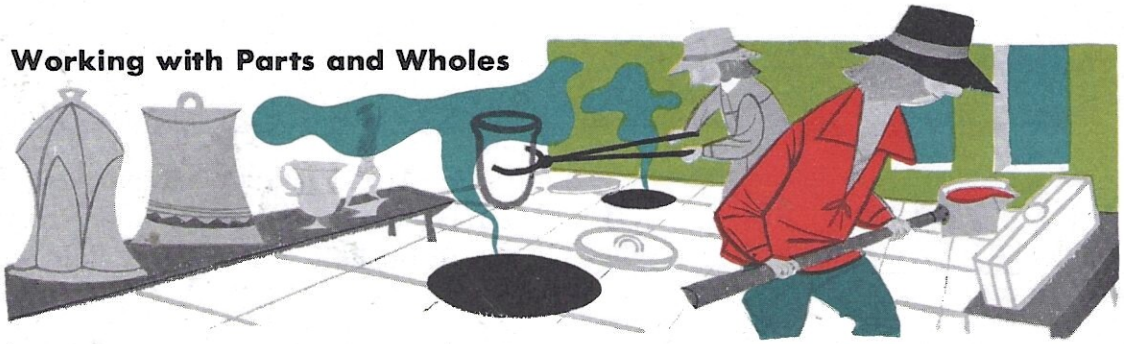
8 12 16

**20.** Miss Jones gave 12 apples to the children who came to a party. Each child got $1\frac{1}{2}$ apples. How many children were at the party?

8 12 16

**21.** One concrete mix is 1 part cement, 2 parts sand, and 3 parts gravel. What fractional part of the mix is cement?

$\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{6}$



▶ Common brass is 2 parts copper and 1 part zinc.

| COPPER $\frac{1}{3}$ | COPPER $\frac{1}{3}$ | ZINC $\frac{1}{3}$ |
|---|---|---|

1. How many pounds of copper are needed to make 60 pounds of brass?

2. How many pounds of zinc are needed to make 540 pounds of brass?

3. A brass kettle weighs 15 pounds. How many pounds of copper were used to make it?

4. A brass cannon weighed 984 pounds. How many pounds of zinc were used to make it?

▶ Pewter is made of 12 parts tin, 2 parts lead, and 1 part copper.

tin lead copper

| $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ | $\frac{1}{15}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

5. A pewter tray weighs $7\frac{1}{2}$ pounds. How many pounds of tin were used to make it? How many pounds of lead? How many pounds of copper?

6. Mrs. Hill's pewter cups and spoons weighed a total of $18\frac{3}{4}$ pounds. How many pounds of tin were used to make them?

7. One bell-maker uses 8 parts copper and 7 parts tin in the bells he makes. Make a drawing to show the parts. How many pounds of copper will he use for a bell that weighs 900 lb.? How many pounds of tin will he use?

8. A church bell weighs 4800 lb. It is made of 16 parts copper, 2 parts tin, 1 part zinc, and 1 part lead. Make a drawing to show the parts. How many pounds of copper were used in the bell? How many pounds of tin? Of zinc? Of lead?

▶ A nickel-silver mixture is 3 parts nickel and 7 parts silver.

9. Make a drawing to show the parts of the nickel-silver mixture.

10. A set of nickel-silver spoons weighs $2\frac{1}{2}$ pounds. How many pounds of silver were needed to make it?

11. A big nickel-silver pitcher weighs $3\frac{3}{4}$ lb. How many pounds of nickel were needed to make it?

12. A jelly recipe calls for 4 pounds of sugar with every 5 pounds of juice. Mrs. Ray has 15 pounds of juice. How many pounds of sugar will she need?

13. One cup of sugar and 2 cups of water will make $2\frac{1}{2}$ cups of medium syrup for canning. How many cups of sugar are needed to make 10 cups of medium syrup?

14. A candy recipe calls for $2\frac{1}{2}$ cups of sugar, $\frac{1}{2}$ cup of water, $\frac{1}{4}$ cup of vinegar, and $\frac{1}{8}$ stick of butter. Mrs. Alcott will use 10 cups of sugar for a large batch of the candy. How much vinegar will she need? How much butter? How much water?

15. Alice weighs $\frac{1}{2}$ as much as her mother. When they stand on the scales together, the total weight is 210 pounds. How much does each weigh?

16. Alma weighs $\frac{1}{3}$ as much as her father. When they stand on the scales together, the total weight is 240 pounds. How much does each weigh? Make a drawing.

17. Howard weighs $\frac{2}{3}$ as much as his father. When they stand on the scales together, the total weight is 300 pounds. How much does each weigh? Make a drawing.

18. The regular price of soup is 3 cans for 25¢. At a special sale, the price is 4 cans for 25 cents. How much can one save per can by purchasing at the sale?

19. Milk was 3 cans for 25 cents. The sale price was 3 cans for 22 cents. How much can one save per can by purchasing at the sale? The Bell family uses 24 cans of milk per month. How much can the family save per month by purchasing milk at the sale price?

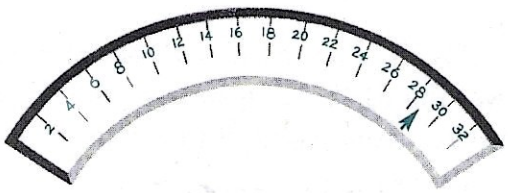
20. Tomatoes were 2 cans for 27 cents. The sale price was 3 cans for 40 cents. How much less per can is the sale price?

21. The sale price of soap is $2\frac{2}{3}$ cents per bar less than the regular price. How many bars does one need to buy to save 80 cents?

22. How many pieces, each $\frac{2}{3}$ yard long, can be cut from 6 yards of ribbon?

## How Well Have You Learned?

If you understand the work of this unit well you can send the pointer of the dial far to the right.




*Give an example of —*

1. Fraction with numerator 5.
2. Fraction with denominator 8.
3. Fraction equivalent to $\frac{3}{4}$.
4. Proper fraction.
5. Improper fraction.
6. Mixed number.
7. Two like fractions.
8. Two unlike fractions.
9. Fraction in lowest terms.
10. Fraction not in lowest terms.

*What happens to the value of a fraction when you —*

11. Multiply numerator by 2?
12. Multiply denominator by 2?
13. Divide numerator by 2?
14. Divide denominator by 2?
15. Multiply both numerator and denominator by 2?
16. Divide both numerator and denominator by 2?
17. Write a proper fraction with the figures 3 and 5.
18. Write an improper fraction with the figures 3 and 5.

*Find each answer in simplest form.*

19. $\frac{1}{5}+\frac{3}{5}$ $\quad \frac{1}{4}+\frac{1}{4}$ $\quad \frac{5}{6}+\frac{1}{6}$ $\quad \frac{7}{8}+\frac{5}{8}$

20. $\frac{1}{2}+\frac{1}{3}$ $\quad \frac{1}{4}+\frac{1}{3}$ $\quad \frac{1}{6}+\frac{1}{3}$ $\quad \frac{1}{4}+\frac{1}{6}$

21. $2\frac{1}{2}+1\frac{3}{4}$ $\quad 4\frac{2}{3}+3\frac{1}{2}$ $\quad 8\frac{1}{3}+2\frac{1}{6}$ $\quad 1\frac{5}{8}+\frac{1}{2}$

22. $\frac{2}{3}-\frac{1}{3}$ $\quad \frac{5}{8}-\frac{1}{8}$ $\quad \frac{5}{6}-\frac{2}{3}$ $\quad \frac{7}{12}-\frac{3}{12}$

23. $\frac{1}{2}-\frac{1}{3}$ $\quad \frac{5}{6}-\frac{1}{2}$ $\quad \frac{3}{4}-\frac{1}{3}$ $\quad \frac{5}{6}-\frac{1}{4}$

24. $4\frac{1}{5}-1\frac{1}{2}$ $\quad 7\frac{1}{2}-2\frac{5}{8}$ $\quad 6\frac{1}{4}-\frac{3}{4}$ $\quad 5-3\frac{1}{3}$

25. $\frac{2}{3}\times\frac{5}{8}$ $\quad 6\times4\frac{2}{3}$ $\quad 3\frac{1}{2}\times3\frac{1}{7}$

26. $\frac{3}{8}\times\frac{2}{5}$ $\quad 4\times37\frac{1}{2}$ $\quad 7\frac{1}{2}\times2\frac{2}{3}$

27. $6\frac{1}{4}\times8$ $\quad 3\frac{3}{4}\times20$ $\quad 2\frac{1}{4}\times\frac{2}{3}$

28. $6\frac{3}{4}\times7\frac{2}{9}$ $\quad 7\frac{3}{16}\times\frac{2}{5}$ $\quad 8\frac{1}{6}\times3\frac{1}{7}$

29. $\frac{5}{8}\times6\frac{2}{3}$ $\quad \frac{6}{7}\times49$ $\quad \frac{2}{9}\times8\frac{5}{6}$

30. $8\div\frac{2}{3}$ $\quad \frac{7}{8}\div2$ $\quad 3\div1\frac{1}{5}$

31. $6\frac{3}{4}\div\frac{3}{4}$ $\quad \frac{3}{4}\div6$ $\quad 7\frac{1}{2}\div1\frac{1}{2}$

32. $\frac{5}{8}\div\frac{1}{2}$ $\quad 2\frac{1}{2}\div6\frac{1}{4}$ $\quad 3\frac{3}{4}\div9$

## Help Yourself to Improve

Do the work on this page to improve your understanding of the work in this unit.

1. Write a fraction with denominator 6 and numerator 5. Show this fraction with a drawing. (25)

2. Write two fractions each equivalent to $\frac{4}{6}$. (26)

3. Copy. Write the missing numerators. (26)

$\frac{1}{2}=\frac{?}{6}$ $\frac{6}{8}=\frac{?}{4}$ $\frac{15}{18}=\frac{?}{12}$

4. Tell what number to divide by to change to lowest terms. (26, 27)

$\frac{12}{16}$ $\frac{3}{12}$ $\frac{15}{18}$ $\frac{12}{32}$ $\frac{24}{36}$

*Find answers in best form.* (27)

5. $\frac{3}{6}+\frac{1}{6}$ $\frac{3}{8}+\frac{3}{8}$ $\frac{2}{10}+\frac{3}{10}$

6. $\frac{7}{12}-\frac{3}{12}$ $\frac{11}{16}-\frac{5}{16}$ $\frac{7}{8}-\frac{3}{8}$

7. Copy. Write the missing numerators. (29)

$1=\frac{?}{5}$ $1\frac{2}{3}=\frac{?}{3}$ $7\frac{1}{2}=6\frac{?}{4}$

8. Is 24 a common denominator for — (31)

$\frac{2}{3}$ $\frac{3}{4}$ $\frac{5}{6}$? $\frac{7}{8}$ $\frac{1}{2}$ $\frac{3}{4}$?

9. Find the least common denominators. (31)

$\frac{2}{3}$ $\frac{3}{4}$ $\frac{5}{6}$ $\frac{7}{8}$ $\frac{1}{2}$ $\frac{3}{4}$

*Using the figures 3, 5, and 8, write —* (28, 29)

10. Three proper fractions

11. Three improper fractions

12. Three mixed numbers

13. Change to whole numbers or mixed numbers. (29)

$\frac{3}{3}$ $\frac{6}{2}$ $\frac{7}{3}$ $\frac{9}{4}$ $\frac{10}{8}$

14. Change to improper fractions. (34, 35)

$2\frac{1}{2}$ $6\frac{1}{4}$ $2\frac{2}{3}$ $1\frac{7}{8}$ $3\frac{1}{7}$

*Find each answer in simplest form.*

15. $\frac{7}{12}+\frac{2}{3}+\frac{3}{8}$ $1\frac{3}{10}+3\frac{1}{3}+4\frac{1}{2}$ $3\frac{1}{4}+1\frac{3}{8}+2\frac{1}{2}$ (31)

16. $\frac{3}{4}-\frac{1}{3}$ $7\frac{1}{2}-1\frac{2}{3}$ $8\frac{3}{4}-3\frac{5}{8}$ (32)

17. $6\times3\frac{1}{3}$ $1\frac{3}{4}\times12$ (35)

18. $\frac{8}{15}\times\frac{3}{4}$ $2\frac{1}{4}\times3\frac{1}{3}$ (35)

19. $4\div\frac{1}{2}$ $6\div\frac{1}{3}$ (40)

20. $4\div\frac{2}{3}$ $6\div\frac{3}{4}$ (41)

21. Each box weighed $2\frac{1}{4}$ lb. How many boxes will weigh 18 lb.? (42, 43)

22. Steak is 68¢ a pound. Find the cost of $1\frac{3}{4}$ lb. (42, 43)

23. Sue worked 12 problems in 20 min. At this rate, how many can she work in 1 hr.? (42, 43)

## Show That You Know

*Find all answers in simplest form.*

1.

| | | | |
|---|---|---|---|
| $2\frac{1}{3}$ | $6\frac{1}{4}$ | $3\frac{3}{4}$ | $4\frac{2}{5}$ |
| $1\frac{1}{6}$ | $3\frac{1}{3}$ | $\frac{5}{8}$ | $\frac{2}{3}$ |
| $+3\frac{1}{2}$ | $+2\frac{5}{6}$ | $+6\frac{2}{3}$ | $+5$ |

2. $6\frac{7}{8}-2\frac{3}{8}$ $\quad$ $8\frac{1}{6}-3\frac{5}{6}$

3. $7\frac{1}{2}-1\frac{3}{4}$ $\quad$ $6\frac{1}{4}-3\frac{1}{3}$

4. $12\times\frac{3}{4}$ $\quad$ $3\frac{1}{3}\times 6$

5. $2\frac{1}{2}\times 1\frac{1}{3}$ $\quad$ $\frac{3}{4}\times\frac{5}{6}$

6. $4\div\frac{2}{3}$ $\quad$ $6\div 1\frac{1}{2}$

7. $7\frac{1}{2}\div 1\frac{1}{4}$ $\quad$ $\frac{5}{6}\div\frac{2}{3}$

8. A baker sells $\frac{3}{4}$-pound fruitcakes. The price is \$1.20 a pound. What is the cost of 1 fruitcake? Of 4 fruitcakes? What is the weight of 6 fruitcakes? Of 15 fruitcakes?

9. Mrs. Stone made $18\frac{3}{4}$ lb. of fudge. She will sell it in $\frac{5}{8}$-pound bags. How many bags will there be?

10. A carpenter sawed an 8-foot board in two. One piece was $3\frac{3}{4}$ ft. long. How long was the other piece?

11. The butcher weighed a roast and said, "Five and three quarter pounds. That will be \$3.45." How much was this per pound?

*Write only the letters that tell the correct answer.*

12. Which pairs are like fractions?

a. $\frac{2}{5}, \frac{3}{5}$ $\quad$ b. $\frac{2}{3}, \frac{2}{5}$

c. $\frac{5}{6}, \frac{7}{6}$ $\quad$ d. $\frac{2}{3}, \frac{4}{6}$

13. Which are proper fractions?

a. $\frac{4}{5}$ $\quad$ b. $\frac{8}{3}$ $\quad$ c. $\frac{6}{6}$ $\quad$ d. $\frac{5}{6}$

14. Which fractions are in lowest terms?

a. $\frac{12}{18}$ $\quad$ b. $\frac{4}{9}$ $\quad$ c. $\frac{8}{15}$ $\quad$ d. $\frac{9}{12}$

15. Which fraction in each row is largest?

| | | | |
|---|---|---|---|
| a. $\frac{3}{7}$ | $\frac{3}{6}$ | $\frac{3}{5}$ | $\frac{3}{8}$ |
| b. $\frac{2}{5}$ | $\frac{5}{9}$ | $\frac{4}{7}$ | $\frac{3}{4}$ |

16. Which pairs are equivalent?

a. $\frac{2}{3}, \frac{9}{12}$ $\quad$ b. $\frac{3}{4}, \frac{8}{12}$

c. $\frac{5}{8}, \frac{10}{16}$ $\quad$ d. $\frac{3}{4}, \frac{6}{8}$

17. The fraction $\frac{4}{6}$ is equivalent to:

a. $\frac{4\times 2}{6\times 2}=\frac{8}{12}$ $\quad$ b. $\frac{4+2}{6+2}=\frac{6}{8}$

c. $\frac{4\div 2}{6\div 2}=\frac{2}{3}$ $\quad$ d. $\frac{4-2}{6-2}=\frac{2}{4}$

18. The least common denominator for $\frac{2}{3}, \frac{5}{6}, \frac{3}{8}$ is:

a. 12 $\quad$ b. 24 $\quad$ c. 30 $\quad$ d. 48

19. $1\frac{1}{2}\times\frac{6}{10}$ equals:

a. $\frac{9}{10}$ $\quad$ b. $\frac{6}{15}$ $\quad$ c. $\frac{9}{15}$ $\quad$ d. $\frac{3}{5}$

## Measures

1. Mrs. Smith bought 5 dozen eggs for $3. Mrs. Fall paid only $2 for a basketful. Can you tell who got the better bargain? Why?

*Explain why one measure in each of the following pairs tells the quantity more exactly than the other.*

2. Bucketful of milk — 3 gallons of milk

3. Bag of potatoes — 10 pounds of potatoes

4. Pinch of salt — $\frac{1}{4}$ teaspoonful of salt

*Find exact answers to as many of the following problems as you can. When you cannot find an exact answer, tell what is lacking in the problem.*

5. A 5-ounce tube of toothpaste costs 65¢. A 3-ounce tube costs 45¢. What is the cost per ounce for each tube? Which is the better bargain?

6. A large tube of toothpaste costs 49¢ and a jumbo tube costs 69¢. Which is the better bargain?

7. A 12-ounce box of soap powder costs 24¢. A 32-ounce box costs 48¢. Which is the better bargain?

8. A large box of soap flakes costs 23¢, but a giant-size box can be bought for 49¢. Which is the better bargain?

9. A 16-ounce box of cereal costs 32¢, but a 6-ounce box costs only 15¢. Which is the better bargain?

■ **Such measures as the ounce, pound, pint, quart, inch, foot, and mile are called standard units of measure.**

▶ Standard units of measure have exact meanings. Buyers should not be misled by such words as **jumbo** and **giant.**

10. Which is larger, a 2-pound or a 3-pound package of soap? Which is largest, a regular-size package, a jumbo package, an economy-size package, or a giant package?

## Measures of Length

1. Ted's notebook is 4 inches long. *Inch* is the unit of measure. The unit of measure is contained 4 times in the length of the notebook.

2. A table is 4 feet long. What is the unit of measure? How many times is the unit of measure contained in the length of the table?

3. Tom's bedroom is 5 yards long. What is the unit of measure? How many times is the unit contained in the length of the room?

4. What unit of measure would you use in telling the distance between cities?

■ **To measure means to**

**a. Choose a suitable unit of measure.**

**b. Count how many times the unit is contained in the thing measured.**

**MEASURES OF LENGTH**

SHORTER DISTANCES

1 inch (in.)

1 foot (ft.) = 12 inches (in.)

1 yard (yd.) = { 3 feet (ft.) / 36 inches (in.) }

LONGER DISTANCES

1 rod (rd.) = { $5\frac{1}{2}$ yards (yd.) / $16\frac{1}{2}$ feet (ft.) }

1 mile (mi.) = { 320 rods (rd.) / 1760 yards (yd.) / 5280 feet (ft.) }

*Tell the unit of measure you would use, and about how many times the unit is contained in the following.*

5. The height of a door.

6. The length of a football field.

7. The length of a new pencil.

8. The length of a schoolroom.

9. The distance around the world at the equator.

■ **In length measure, the sign " means inch or inches; the sign ' means foot or feet.**

10. Read these length measures: 7′ 9″; 16″; 4′ 1″; $4\frac{1}{2}$″; 13′ 2″

### Adding Units of Measure

11. Bob helped his father build a recreation room. When it was nearly finished, Bob's father asked him to get a strip of molding long enough to provide one piece 5′ 7″ long and another piece 1′ 9″ long.

The example below shows how Bob added. Why was his first answer not in best form? What steps did he follow to change 6 ft. 16 in. to 7 ft. 4 in.?

$$\begin{array}{r} 5 \text{ ft. } 7 \text{ in.} \\ +1 \text{ ft. } 9 \text{ in.} \\ \hline 6 \text{ ft. } 16 \text{ in.} = 7 \text{ ft. } 4 \text{ in.} \end{array}$$

12. Change to feet and inches: 19 in.; 32 in.; 15 in.; 24 in.

13. Change to yards and inches: 42 in.; 78 in.; 37 in.; 111 in.

14. Change to yards and feet: 5 ft.; 7 ft.; 16 ft.; 23 ft.

15. Change to miles and rods: 400 rd.; 720 rd.; 644 rd.; 327 rd.

*Find each sum in best form.*

16.
$$\begin{array}{r} 4 \text{ yd. } 1 \text{ ft.} \\ +2 \text{ yd. } 2 \text{ ft.} \end{array} \qquad \begin{array}{r} 3' \ 7'' \\ +2' \ 8'' \end{array}$$

17.
$$\begin{array}{r} 3 \text{ yd. } 2 \text{ ft.} \\ 2 \text{ ft.} \\ +4 \text{ yd. } 1 \text{ ft.} \end{array} \qquad \begin{array}{r} 5'10'' \\ 9' \ 8'' \\ +2' \ 9'' \end{array}$$

### Multiplying Units of Measure

18. The recreation room which Bob and his father built was square. Each wall was 6 yards, 2 feet long. Bob's father asked him to figure how much molding they had nailed at the top of the walls around the entire room. Explain Bob's multiplication.

$$\begin{array}{r} 6 \text{ yd. } 2 \text{ ft.} \\ \times 4 \\ \hline 24 \text{ yd. } 8 \text{ ft.} = 26 \text{ yd. } 2 \text{ ft.} \end{array}$$

19. Bob planned to build storage shelves at one end of the recreation room. He wanted 6 shelves in a space 3 feet, 5 inches wide. How much shelving did he need?

*Multiply. Find each product in best form.*

20.
$$\begin{array}{r} 7 \text{ yd. } 2 \text{ ft.} \\ \times 5 \end{array} \qquad \begin{array}{r} 2' \ 9'' \\ \times 4 \end{array}$$

21.
$$\begin{array}{r} 5 \text{ yd. } 1 \text{ ft.} \\ \times 8 \end{array} \qquad \begin{array}{r} 3' \ 7'' \\ \times 6 \end{array}$$

### Subtracting Units of Measure

22. The building supply store had a rule that unused rubber floor molding might be returned in amounts of 3 feet or more. Bob had 5 ft. 3 in. of molding and still had to install 1 ft. 9 in. Would the left-over molding be enough to return?

Study Bob's subtraction. Be sure that you understand the borrowing. Explain each step.

$$\begin{array}{rl} 5 \text{ ft. } 3 \text{ in.} = & 4 \text{ ft. } 15 \text{ in.} \\ -1 \text{ ft. } 9 \text{ in.} = & -1 \text{ ft. } \ 9 \text{ in.} \\ \hline & 3 \text{ ft. } \ 6 \text{ in.} \end{array}$$

*Subtract. Explain each step.*

23.
$$\begin{array}{r} 9 \text{ yd. } 1 \text{ ft.} \\ 2 \text{ yd. } 2 \text{ ft.} \end{array} \qquad \begin{array}{r} 8' \ 2'' \\ 5' \ 7'' \end{array}$$

24.
$$\begin{array}{r} 7 \text{ yd.} \\ 2 \text{ yd. } 30 \text{ in.} \end{array} \qquad \begin{array}{r} 6' \ 5'' \\ 5' \ 9'' \end{array}$$

### Dividing Units of Measure

25. When Bob's recreation room was finished, there remained a board 12 feet, 6 inches long. Bob

cut it into 6 equal pieces for shelves in the garage. How long was each shelf? Explain Bob's division.

$$6\overline{)12 \text{ ft. } 6 \text{ in.}}\quad 2 \text{ ft. } 1 \text{ in.}$$

**26.** Why did this dividend have to be changed? Find the quotient.

$$5\overline{)3 \text{ ft. } 4 \text{ in.}} = 5\overline{)40 \text{ in.}}$$

**27.** Divide. If necessary, change the dividends before dividing.

$7\overline{)5 \text{ ft. } 3 \text{ in.}}$ $6\overline{)4' \ 6''}$

**28.** Copy this division. Explain each step. Check by multiplying.

$$\begin{array}{r} 3 \text{ ft.} \quad 8 \text{ in.} \\ 8\overline{)29 \text{ ft.} \quad 4 \text{ in.}} \\ \underline{24 \text{ ft.}} \\ 5 \text{ ft.} = 60 \text{ in.} \\ \underline{64 \text{ in.}} \\ 64 \text{ in.} \end{array}$$

*Divide. Check by multiplying.*

**29.** $7\overline{)53 \text{ yd. } 2 \text{ ft.}}$ $8\overline{)51' \ 4''}$

**30.** $6\overline{)52 \text{ rd. } 2 \text{ yd.}}$ $7\overline{)21' \ 7''}$

**31.** $2\overline{)11 \text{ yd. } 1 \text{ ft.}}$ $15\overline{)82' \ 6''}$

## Finding More Exact Measures

**1.** Some boys wanted to check whether their softball diamond was laid out properly. Jim figured that the distance from home to first was correct (60 ft.) because he took 20 long steps between the two points.

Fred measured with a 1-foot ruler. He said that the distance was 59 ft. Tom, who used a yardstick, measured a little less than 20 yd. Jack and Bill, using a measuring tape, found the distance to be 58 ft. 10 in.

Why were all the measurements different? Which of the measurements was likely to be the most exact? Why?

**2.** Measure the height of this page. Is it closer to 8 or to 9 inches? Using *inch* as the unit, we say that the page is ▯ inches high.

**3.** What is the height of this page using $\frac{1}{4}$ inch as the unit of measurement? Why does this unit give a more exact measure than the 1-inch unit?

**4.** Explain why you can find a more exact measure (a) by using a smaller unit of measure, and (b) by measuring more carefully.

## Hours and Minutes

*Study and explain each step in the following problems. Copy and complete the work.*

1. Joy worked 2 hours and 50 minutes on Friday and 4 hours and 35 minutes on Saturday. How long did she work on the two days?

$$\begin{array}{r} 2 \text{ hr. } 50 \text{ min.} \\ +\,4 \text{ hr. } 35 \text{ min.} \\ \hline 6 \text{ hr. } 85 \text{ min.} = \square \text{ hr. } \square \text{ min.} \end{array}$$

2. Mr. Dow went on a trip that he figured would take 8 hours. How much longer did he still have to drive when he had traveled for 5 hours and 45 minutes?

$$\begin{array}{rl} 8 \text{ hr.} & = 7 \text{ hr. } 60 \text{ min.} \\ -\,5 \text{ hr. } 45 \text{ min.} & = 5 \text{ hr. } 45 \text{ min.} \\ \hline & \square \text{ hr. } \square \text{ min.} \end{array}$$

3. Jack worked 2 hours and 15 minutes a day for 5 days. How long did he work in all?

$$\begin{array}{r} 2 \text{ hr. } 15 \text{ min.} \\ \times 5 \\ \hline 10 \text{ hr. } 75 \text{ min.} = \square \text{ hr. } \square \text{ min.} \end{array}$$

4. Lynn has 2 hours, 15 minutes for study. He can use one third of it for arithmetic. How much time can he use for arithmetic?

$$3\overline{)2 \text{ hr. } 15 \text{ min.}} = 3\overline{)135 \text{ min.}}$$

$$\square \text{ min.}$$

*Write answers in best form.*

5. $\begin{array}{r} 7 \text{ hr. } 36 \text{ min.} \\ +\,2 \text{ hr. } 44 \text{ min.} \\ \hline \end{array}$ $\begin{array}{r} 5 \text{ hr. } 16 \text{ min.} \\ +\,48 \text{ min.} \\ \hline \end{array}$

6. $\begin{array}{r} 2 \text{ hr. } 15 \text{ min.} \\ 4 \text{ hr.} \\ +\,3 \text{ hr. } 55 \text{ min.} \\ \hline \end{array}$ $\begin{array}{r} 3 \text{ hr. } 27 \text{ min.} \\ 1 \text{ hr. } 18 \text{ min.} \\ +\,2 \text{ hr. } 15 \text{ min.} \\ \hline \end{array}$

7. $\begin{array}{r} 3 \text{ hr. } 48 \text{ min.} \\ -\,1 \text{ hr. } 18 \text{ min.} \\ \hline \end{array}$ $\begin{array}{r} 7 \text{ hr. } 12 \text{ min.} \\ -\,3 \text{ hr. } 36 \text{ min.} \\ \hline \end{array}$

8. $\begin{array}{r} 5 \text{ hr. } 16 \text{ min.} \\ -\,4 \text{ hr. } 48 \text{ min.} \\ \hline \end{array}$ $\begin{array}{r} 2 \text{ hr. } 24 \text{ min.} \\ -\,54 \text{ min.} \\ \hline \end{array}$

9. $\begin{array}{r} 3 \text{ hr. } 48 \text{ min.} \\ \times 3 \\ \hline \end{array}$ $\begin{array}{r} 2 \text{ hr. } 54 \text{ min.} \\ \times 4 \\ \hline \end{array}$

10. $\begin{array}{r} 1 \text{ hr. } 16 \text{ min.} \\ \times 6 \\ \hline \end{array}$ $\begin{array}{r} 44 \text{ min.} \\ \times 9 \\ \hline \end{array}$

11. 6 hr. 20 min. $\div 5$

12. 13 hr. 12 min. $\div 6$

13. 6 hr. 24 min. $\div 8$

14. 2 hr. 8 min. $\div 4$

A time, as 10 minutes after 9, may be written as 9:10. Remember what A.M. and P.M. mean.

*Find the time from —*

15. 9:10 A.M. till 11:40 A.M.

16. 8:50 P.M. till 10:15 P.M.

17. Alice worked from 11:30 A.M. till 2:15 P.M. How long did she work before noon? How long after noon? How long altogether?

## Distance and Time

1. Bill read a newspaper story about automobile safety engineers. The story mentioned that a certain car traveled 44 feet per second. Bill was used to thinking of speed as a certain number of "miles per hour." Choose the number below which you think comes closest to the number of miles per hour the car was traveling.

15 30 45 60 75

THINK: There are 60 seconds in 1 minute. The car traveled 60 × 44 feet, or 2640 feet, per minute. There are 60 minutes in 1 hour. The car traveled 60 × 2640 feet, or 158,400 feet, per hour. There are 5280 feet in 1 mile. The car traveled 158,400 ÷ 5280, or ? m.p.h.

2. How many miles per hour is a car traveling if it moves $73\frac{1}{3}$ feet per second?

3. How many miles per hour is a car traveling if it moves 880 feet per minute?

4. An automobile is going 45 miles per hour. How many feet will it go in 1 minute? In 1 second?

THINK: 45 miles per hour = ? feet per hour.

5. How far will an automobile move in 1 second when it is going 60 miles per hour? In $1\frac{1}{2}$ seconds?

6. A car is going 36 miles per hour. How far will it go in 1 minute? In 1 second? In $1\frac{1}{4}$ seconds?

7. Joe read that a plane had flown a distance of 2500 miles in 5 hours. How many miles per hour is this?

THINK: If the plane went 2500 miles in 5 hours, it went 2500 ÷ 5, or ? miles in 1 hour.

8. Mrs. Smith drove 130 miles in $3\frac{1}{3}$ hours. What was her speed in miles per hour?

9. Jack rode his bicycle 4 miles in $\frac{1}{2}$ hour. What was his speed?

10. How long will it take Mr. Fine to go 153 miles if he travels at a rate of 36 miles per hour?

THINK: If Mr. Fine goes 36 miles in 1 hour, to go 153 miles will take 153 ÷ 36, or ? hours.

11. Mr. Gore drove 81 miles in 2 hours and 15 minutes. What was his speed in miles per hour?

THINK: 15 minutes is what fraction of an hour?

12. Mr. Hayes drove 133 miles in 3 hours and 10 minutes. Mr. Chandler drove 150 miles in 3 hours and 20 minutes. Who drove at the faster rate?

## No Pencils, Please

This sign means that you should not use your pencil except to write answers.

*Reduce to lowest terms.*

| | | | | | |
|---|---|---|---|---|---|
| 1. | $\frac{3}{6}$ | $\frac{9}{15}$ | $\frac{8}{16}$ | $\frac{9}{30}$ | $\frac{6}{18}$ |
| 2. | $\frac{6}{8}$ | $\frac{4}{12}$ | $\frac{3}{24}$ | $\frac{12}{32}$ | $\frac{2}{10}$ |
| 3. | $\frac{4}{6}$ | $\frac{12}{15}$ | $\frac{4}{16}$ | $\frac{15}{36}$ | $\frac{5}{50}$ |
| 4. | $\frac{2}{8}$ | $\frac{8}{12}$ | $\frac{8}{24}$ | $\frac{16}{32}$ | $\frac{4}{18}$ |
| 5. | $\frac{2}{4}$ | $\frac{4}{10}$ | $\frac{6}{24}$ | $\frac{24}{32}$ | $\frac{20}{25}$ |
| 6. | $\frac{4}{8}$ | $\frac{6}{15}$ | $\frac{12}{16}$ | $\frac{8}{36}$ | $\frac{9}{15}$ |
| 7. | $\frac{2}{6}$ | $\frac{6}{10}$ | $\frac{16}{24}$ | $\frac{12}{30}$ | $\frac{18}{27}$ |
| 8. | $\frac{6}{9}$ | $\frac{6}{12}$ | $\frac{9}{24}$ | $\frac{24}{36}$ | $\frac{14}{16}$ |
| 9. | $\frac{5}{10}$ | $\frac{9}{12}$ | $\frac{6}{16}$ | $\frac{9}{36}$ | $\frac{8}{20}$ |
| 10. | $\frac{3}{9}$ | $\frac{5}{15}$ | $\frac{18}{24}$ | $\frac{28}{32}$ | $\frac{15}{24}$ |

*Change to mixed numbers or whole numbers.*

| | | | | | |
|---|---|---|---|---|---|
| 11. | $\frac{3}{2}$ | $\frac{7}{5}$ | $\frac{13}{6}$ | $\frac{15}{9}$ | $\frac{24}{5}$ |
| 12. | $\frac{8}{3}$ | $\frac{6}{4}$ | $\frac{22}{5}$ | $\frac{20}{8}$ | $\frac{17}{6}$ |
| 13. | $\frac{7}{4}$ | $\frac{7}{3}$ | $\frac{10}{8}$ | $\frac{12}{6}$ | $\frac{28}{9}$ |
| 14. | $\frac{9}{5}$ | $\frac{9}{3}$ | $\frac{18}{8}$ | $\frac{11}{8}$ | $\frac{15}{8}$ |
| 15. | $\frac{8}{6}$ | $\frac{7}{2}$ | $\frac{14}{6}$ | $\frac{21}{9}$ | $\frac{30}{4}$ |
| 16. | $\frac{6}{3}$ | $\frac{9}{4}$ | $\frac{11}{3}$ | $\frac{10}{6}$ | $\frac{28}{7}$ |
| 17. | $\frac{8}{2}$ | $\frac{6}{5}$ | $\frac{12}{8}$ | $\frac{28}{8}$ | $\frac{22}{3}$ |
| 18. | $\frac{9}{6}$ | $\frac{9}{8}$ | $\frac{14}{8}$ | $\frac{22}{7}$ | $\frac{20}{9}$ |
| 19. | $\frac{5}{2}$ | $\frac{8}{8}$ | $\frac{15}{6}$ | $\frac{30}{9}$ | $\frac{32}{8}$ |
| 20. | $\frac{8}{4}$ | $\frac{3}{3}$ | $\frac{13}{4}$ | $\frac{18}{8}$ | $\frac{18}{2}$ |

*Change to improper fractions.*

| | | | | | |
|---|---|---|---|---|---|
| 21. | $1\frac{1}{4}$ | $3\frac{5}{8}$ | $6\frac{2}{3}$ | $12\frac{1}{2}$ | $5\frac{7}{8}$ |
| 22. | $2\frac{3}{4}$ | $3\frac{1}{3}$ | $1\frac{7}{8}$ | $16\frac{2}{3}$ | $10\frac{3}{4}$ |
| 23. | $6\frac{3}{8}$ | $4\frac{1}{6}$ | $3\frac{1}{7}$ | $2\frac{4}{5}$ | $12\frac{1}{3}$ |

*Change to improper fractions. Write the missing numerators.*

| | | |
|---|---|---|
| 24. | $1\frac{1}{2} = \frac{?}{2} = \frac{?}{4} = \frac{?}{6}$ | $1\frac{2}{3} = \frac{?}{3} = \frac{?}{6} = \frac{?}{12}$ |
| 25. | $2\frac{1}{4} = \frac{?}{4} = \frac{?}{8} = \frac{?}{12}$ | $2\frac{4}{5} = \frac{?}{5} = \frac{?}{10} = \frac{?}{15}$ |
| 26. | $4\frac{1}{6} = \frac{?}{6} = \frac{?}{12} = \frac{?}{18}$ | $2\frac{3}{4} = \frac{?}{4} = \frac{?}{8} = \frac{?}{16}$ |
| 27. | $3\frac{2}{5} = \frac{?}{5} = \frac{?}{10} = \frac{?}{15}$ | $1\frac{5}{6} = \frac{?}{6} = \frac{?}{12} = \frac{?}{24}$ |

*Think the number that belongs in place of each question mark and write the fraction.*

| | | | |
|---|---|---|---|
| 28. | $\frac{3}{4} = \frac{?}{12}$ | $\frac{5}{6} = \frac{?}{12}$ | $\frac{1}{3} = \frac{?}{6}$ |
| 29. | $\frac{2}{3} = \frac{?}{12}$ | $\frac{1}{2} = \frac{?}{12}$ | $\frac{1}{2} = \frac{?}{16}$ |
| 30. | $\frac{1}{2} = \frac{?}{6}$ | $\frac{3}{4} = \frac{?}{8}$ | $\frac{2}{3} = \frac{?}{9}$ |
| 31. | $\frac{7}{8} = \frac{?}{16}$ | $\frac{3}{4} = \frac{?}{16}$ | $\frac{3}{8} = \frac{?}{16}$ |

*Think the number that belongs in place of each question mark and write the completed number.*

| | | | |
|---|---|---|---|
| 32. | $6\frac{3}{2} = 7\frac{?}{2}$ | $3\frac{11}{6} = 4\frac{?}{6}$ | $4\frac{5}{3} = 3\frac{?}{3}$ |
| 33. | $4\frac{7}{3} = 6\frac{?}{3}$ | $7\frac{8}{5} = 8\frac{?}{5}$ | $\frac{8}{7} = 1\frac{?}{7}$ |
| 34. | $4\frac{3}{3} = \square$ | $5\frac{8}{4} = \square$ | $5\frac{9}{3} = \square$ |
| 35. | $7\frac{6}{2} = \square$ | $8\frac{10}{5} = \square$ | $\frac{12}{2} = \square$ |
| 36. | $6\frac{1}{4} = 5\frac{?}{4}$ | $8\frac{1}{3} = 7\frac{?}{3}$ | $9\frac{2}{3} = 8\frac{?}{3}$ |
| 37. | $8\frac{1}{6} = 7\frac{?}{6}$ | $2\frac{5}{8} = 1\frac{?}{8}$ | $4\frac{2}{5} = 3\frac{?}{5}$ |

## Measures of Weight

| MEASURES OF WEIGHT |
| --- |
| 1 ounce (oz.) |
| 1 pound (lb.) = 16 ounces (oz.) |
| 1 ton (T.) = 2000 pounds (lb.) |

1. Change to ounces: 1 lb. 12 oz.; 4 lb.; 2 lb. 10 oz.; 3 lb. 6 oz.

2. Change to pounds and ounces: 30 oz.; 36 oz.; 48 oz.; 60 oz.

3. A 6-cent candy bar weighs $1\frac{1}{3}$ ounces. What is the cost per ounce? How many of these candy bars are in a pound? What is the cost per pound of the candy bars?

4. Candy bars that weigh $1\frac{2}{3}$ ounces cost \$1 per dozen. What is the weight of a dozen of these candy bars? What is the cost per ounce? Per pound?

5. A 9-cent candy bar weighs $2\frac{1}{4}$ ounces. What is the cost per ounce? Per pound?

6. A cup of sugar weighs 8 ounces. What is the weight in pounds and ounces of $2\frac{1}{4}$ cups of sugar?

7. Mrs. Nelson took 2 pounds, 12 ounces from a 10-pound bag of sugar. How much was left in the bag?

A lunchroom buys butter which has 4 sticks of butter in each 1-pound box.

8. What is the weight in ounces of one stick of butter?

9. The lunchroom cuts each stick into 16 pats. If each pound of butter costs 60¢ and the lunchroom sells each pat for 3¢, what is the gain on a pound of butter?

At a farm produce market, the average weight of large eggs was $1\frac{7}{8}$ ounces and that of small eggs was $1\frac{1}{4}$ ounces.

10. What is the weight of a dozen large eggs? A dozen small eggs?

11. The large eggs cost 45¢ per dozen. How much is this per ounce?

12. At 2¢ per ounce, what should be the cost of a dozen small eggs?

13. How many 2-ounce servings can be made from 5 pounds of cheese?

14. A recipe for jelly calls for a pound of sugar for each $1\frac{1}{4}$ pounds of juice. How much sugar is needed for $7\frac{1}{2}$ pounds of juice?

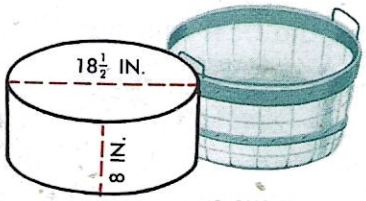
15. Change to pounds: $5\frac{1}{4}$ T.; $6\frac{3}{4}$ T.; $3\frac{1}{2}$ T.; $2\frac{3}{5}$ T.

16. Change to tons: 6000 lb.; 5000 lb.; 7500 lb.; 6750 lb.

17. What is the cost of 200 pounds of fertilizer at the rate of $85 per ton?

18. What is the cost of $\frac{1}{4}$ ton of fertilizer at the rate of $4.35 per 100-pound bag?

At one time corn, wheat, coal, and other goods were sold by the bushel, a measure of this shape and size:



1 BUSHEL

The bushel has become a definite weight, because it is easier to weigh goods than it is to fill a bushel measure many times. Since laws have been passed to regulate the weight of a bushel, we speak of *legal* bushels.

19. The legal weight of a bushel of wheat, as fixed by the United States government, is 60 pounds. How many bushels are there in $3\frac{3}{4}$ tons of wheat?

20. In most states, a legal bushel of potatoes weighs 60 pounds. A store bought 250 bushels of potatoes. How many pounds was this?

21. The Marsh family uses 15 pounds of potatoes per week. How many bushels is this per year?

22. The legal weight of a bushel of oats is only 32 pounds. How many bushels are there in 1 ton of oats?

23. Twenty-five bushels of coal make a ton. What is the weight of one bushel of coal?

24. The price of coal is $16 a ton or 75¢ a bushel. How much can you save per ton when you buy coal at the ton rate?

*Complete and explain the next four examples.*

25.
$$\begin{array}{r} 3 \text{ lb. } 12 \text{ oz.} \\ +\,2 \text{ lb. } 9 \text{ oz.} \\ \hline 5 \text{ lb. } 21 \text{ oz} = \text{? lb. ? oz.} \end{array}$$

26.
$$\begin{array}{r} 7 \text{ lb. } 8 \text{ oz.} = 6 \text{ lb. ? oz.} \\ -\,2 \text{ lb. } 14 \text{ oz.} = 2 \text{ lb. } 14 \text{ oz.} \\ \hline \text{? lb. ? oz.} \end{array}$$

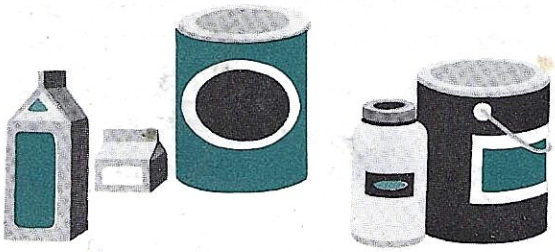
27.
$$\begin{array}{r} 2 \text{ lb. } 6 \text{ oz.} \\ \times 8 \\ \hline 16 \text{ lb. } 48 \text{ oz.} = \text{? lb.} \end{array}$$

28. $6\overline{)3 \text{ lb. } 6 \text{ oz.}} = 6\overline{)\text{? oz.}}$ ? oz.

29. Add 2 lb. 12 oz. and 1 lb. 9 oz.

30. Subtract 14 oz. from 2 lb. 8 oz.

## Liquid Measure



| LIQUID MEASURE | |
|---|---|
| 1 fluid ounce (fl. oz.) | |
| 1 pint (pt.) | = 16 fluid ounces |
| 1 quart (qt.) | = 2 pints (pt.) |
| 1 gallon (gal.) | = 4 quarts (qt.) |

1. Mr. Black's dairy farm produces 15 gallons of milk a day. How many quarts is this?

2. Mr. Jones sells $1\frac{1}{4}$ gallons of cream a day, in half-pint bottles. How many bottles is this?

3. Mrs. Kohl uses $\frac{1}{3}$ pint of ice cream for a serving. How many gallons of ice cream will she need for 60 servings?

4. Name the products that would be sold in the containers in the pictures above. How much will each container hold?

▶ The capacity of glasses and cups for tea, coffee, or cocoa is given in *fluid ounces* (fl. oz.). A pint is equal to 16 fluid ounces. Fluid ounces are marked on measuring cups.

5. Mrs. Kohl will serve 5 ounces of tea per person. How many quarts of tea will she need for 60 servings? Choose the best answer: 8; 9; 10.

6. If Mrs. Kohl had served 7 oz. of tea per person, how many quarts would she have needed? Choose the best answer: 12; 13; 14.

7. How many quarts of lemonade are needed to fill thirty 12-ounce glasses? Choose the best answer: 10; 11; 12.

8. The wrapper on the can says that a gallon of paint will cover 500 square feet. Mr. Kerr figures he has 1250 square feet to paint. How much paint (in gallons and quarts) should he buy?

9. A gallon of varnish will cover 700 square feet. Will a pint of varnish be enough for 80 square feet? Prove your answer.

10. A 6-ounce bottle of vanilla extract is 90 cents. At this rate, what should be the price of a 5-ounce bottle?

11. A 55-gallon drum of motor oil is $35.20. How much is this per gallon? Per quart?

## Dry Measure

1. Dick picked enough berries to fill a $3\frac{1}{2}$-quart milk pail. When he put the berries into berry boxes, he had enough to fill only 3 quart boxes.

Dick could not understand this until his mother told him that berries and other non-liquids are measured by *dry measure* and that a quart in dry measure is not the same as a quart in liquid measure. Can you tell from Dick's experience whether the capacity of a quart in dry measure is greater or less than the capacity of a quart in liquid measure? Explain.

| DRY MEASURE |
|---|
| 1 pint (pt.) |
| 1 quart (qt.) = 2 pints (pt.) |
| 1 peck (pk.) = 8 quarts (qt.) |
| 1 bushel (bu.) = 4 pecks (pk.) |

2. Name some things besides berries that you have seen sold in pint or quart boxes.

3. Name some things, such as apples, that you have seen sold by the bushel or peck.

4. Mr. Cossi put a peck of gooseberries into quart boxes. He sold the berries at 40¢ a quart. How much did he get for the peck?

5. Mr. Cossi put a peck of currants into pint boxes. He sold the currants at 30¢ a pint. How much did he get for the peck?

6. A half peck of potatoes is 15¢. At this rate, what is the cost of a bushel of potatoes?

7. Mr. Noll feeds his horse 2 quarts of oats per day. At this rate, how many days will a bushel of oats last?

*Complete and explain.*

8. 1 pk. 5 qt.
   +1 pk. 4 qt.
   2 pk. 9 qt. = ☐ pk. ☐ qt.

9. 6 bu. 2 pk. = 5 bu. ☐ pk.
   −3 bu. 3 pk. = 3 bu. 3 pk.
   ☐ ☐

10. 1 pk. 6 qt.
    × 2
    2 pk. 12 qt. = ☐ pk. ☐ qt.

11. $3\overline{)2 \text{ bu. } 1 \text{ pk.}} = 3\overline{)\square \text{ pk.}}$ (☐ pk.)

*Write answers in best form.*

12. 1 pk. 6 qt. + 1 pk. 7 qt. = ?
    5 bu. 3 pk. + 2 bu. 3 pk. = ?

13. 4 bu. 2 pk. − 1 bu. 3 pk. = ?
    3 pk. 2 qt. − 2 pk. 6 qt. = ?

14. 1 pk. 3 qt. × 3 = ?
    1 qt. 3 pt. × 3 = ?

15. $6\overline{)1 \text{ bu. } 2 \text{ pk.}}$ = ?
    $4\overline{)3 \text{ pk. } 4 \text{ qt.}}$ = ?

## Using Measures in Problems

1. Mrs. Gray wanted to serve a quarter pint of ice cream to each of 16 guests at a party. How many quarts should she buy?

2. Bob dug 1 bushel and 3 pecks of potatoes from one row in his field. He has 12 rows in all. How many bushels of potatoes can he expect to get?

3. A 5-gallon can of lemonade is divided equally among 8 thermos jugs. How many pints of lemonade are put into each jug?

4. Last year Joan weighed 72 pounds, 10 ounces. Now she weighs exactly 85 pounds. How much has she gained?

5. Mary has 5 assignments to prepare in 3 hours. If she divides her time equally, how many minutes can she give to each assignment?

6. Mrs. Brown found that she had 6 pounds, 6 ounces of potatoes. She wanted them to last for 4 meals. If she divided them equally, how much did she have for each meal?

7. Tom can carry 25 pounds of newspapers in his bag. Each paper weighs 5 ounces. How many papers can he put into the bag?

8. Mr. West raised 78 bushels of tomatoes. He put these in $\frac{1}{2}$-peck baskets and sold them at his roadside stand. How many $\frac{1}{2}$-peck baskets did he have for sale?

9. Mrs. West bought some curtains that were each 81 inches long. If she cut 1 foot, 3 inches from the length of each curtain, what did each curtain then measure? If she used 5 inches from each of the shortened curtains to make a hem, what was the length of each hemmed curtain? Draw a picture to prove your answer.

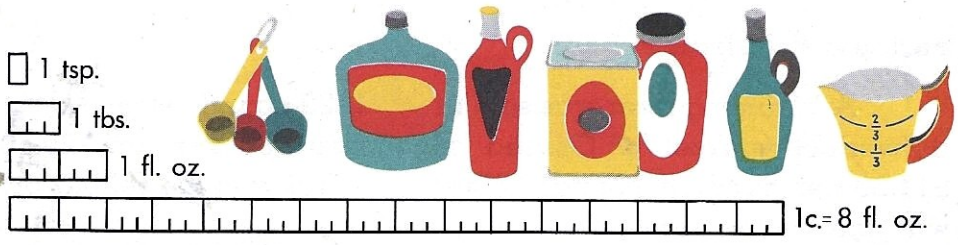
10. Mrs. Crow made 3 gallons of grape juice and put it up in $\frac{3}{4}$-pint bottles. How many bottles were there?

11. Mrs. Miller bought 1 bushel of potatoes for $1.80. The price for 1 peck of potatoes was 50¢. How much did she save on each peck by buying the whole bushel at the bargain price?

12. A man traveling at 30 miles per hour saw a roadside stand. It took him 5 seconds to decide whether or not to stop. How many feet did he travel while deciding?

13. Ted is building a bookcase. He needs 6 boards measuring 2 feet, 8 inches each. How many feet of lumber will he need?

## Kitchen Measures




1. While shopping for her mother, Joy noticed that one brand of orange juice cost 24¢ for a 1-quart can. Another brand cost 23¢ for a can marked "46 fl. oz." Which price was the better bargain?

The liquid measures in the table below are used in measuring small quantities of food and other liquids. In cooking they are used for dry ingredients, such as salt and sugar, as well as for liquids.

| KITCHEN MEASURES | |
|---|---|
| 1 teaspoon (tsp.) | |
| 1 tablespoon (tbs.) | = 3 teaspoons |
| 1 cup (c.) | = 16 tablespoons |
| 1 pint (pt.) | = 2 cups |
| 1 quart (qt.) | = 2 pints |
| 1 fluid ounce (fl. oz.) | |
| 1 cup (c.) | = 8 fluid ounces |
| 1 pint (pt.) | = 16 fluid ounces |

2. A meat loaf recipe called for one tablespoon of salt. Joy used a teaspoon to measure the salt. How many teaspoons of salt did she use?

3. How many pints are there in a can marked "46 fl. oz."?

4. A tall can of evaporated milk contains 13 fluid ounces. How many cups is this? What fraction of a pint is this?

5. A bottle of flavoring is marked "2 fl. oz." What fraction of a cup is this? How many teaspoons is this?

6. Two fluid ounces of pure vanilla extract costs 60¢. Vanillin costs 45¢ for 5 fluid ounces. What is the cost per ounce of each?

7. A 4-ounce bottle of hot sauce costs 24¢. At this rate, what should be the cost of a 5-ounce bottle? What should be the cost of a $5\frac{1}{4}$-ounce bottle if a $4\frac{1}{2}$-ounce bottle costs 30¢?

8. A 12-ounce bottle of orange drink costs $7\frac{1}{2}$¢. What should be the cost of an 8-ounce bottle? Of a 10-ounce bottle?

9. Choose the correct answer: 16 fl. oz. = (1 lb.; 1 pt.).

10. A can of evaporated milk is marked "13 fl. oz." It is also marked "Net Weight — $14\frac{1}{2}$ oz." What do these two markings mean?

**Business Problems**

1. A Wyoming steer was sold at a livestock market in Omaha at $15.50 per hundred pounds. What was the selling price per pound? What did the steer cost if it weighed 700 pounds.

▶ Large animals like cattle are sold by the *hundredweight*, a measure of 100 pounds. Hundredweight is abbreviated **cwt.**

2. The rancher paid $1.35 per cwt. to have the steer hauled to Omaha. The selling expenses were 30¢ per cwt. How much did the rancher actually get from the sale of the 700-pound steer at $15.50 per cwt.?

3. An Iowa stock feeder bought the 700-pound steer at $15.50 per cwt. He paid $.35 per cwt. to have the steer hauled to his feed lot. What was the total cost of the steer to the Iowa feeder?

4. In 240 days the weight of the steer increased from 700 lb. to 1120 lb. What was the average gain per day?

5. The steer ate food worth $113.40 in gaining 420 lb. What was the worth of food per pound of gain?

6. The Iowa feeder sold the 1120-pound steer to a Chicago meat packer for $25.50 per cwt. What was the selling price?

7. This is part of a page from the feeder's account book. Copy the page. Fill in all blanks. Read the sign @ as "at."

| | |
|---|---|
| Cost of steer (700 lb. @ $15.50 per cwt.) | $_____ |
| Hauling to feed lot (700 lb. @ 35¢ per cwt.) | $_____ |
| Feed | $113.40 |
| Hauling to Chicago (1120 lb. @ 30¢ per cwt.) | $_____ |
| Total cost and expenses | $_____ |
| Selling price (1120 lb. @ $25.50 per cwt.) | $_____ |
| Gain (or loss) | $_____ |

8. This is taken from the packer's account book. Copy. Fill in all blanks.

| | |
|---|---|
| Paid for steer (1120 lb. @ $25.50 per cwt.) | $_____ |
| Slaughtering expenses (1120 lb. @ 50¢ per cwt.) | $_____ |
| Received for beef (660 lb. @ $43.50 per cwt.) | $_____ |
| Received for by-products (Hide, tallow, etc.) | $ 14.66 |
| Gain (or loss) | $_____ |

If the packer had not counted in the by-products, how much would he have gained or lost?

9. A butcher in Washington, D.C., bought the beef. This is from the butcher's account book. Copy. Fill in all blanks.

| | |
|---|---|
| Cost of beef (660 lb. @ $43.50 per cwt.) | $_____ |
| Hauling to butcher shop (660 lb. @ $2 per cwt.) | $_____ |
| Selling expenses | $58.24 |
| Received from sale of beef (620 lb. @ average of 62¢ a pound. There was a loss of 40 lb. in cutting, waste, and shrinkage.) | $_____ |
| Gain (or loss) | $_____ |

10. The butcher figured that the average side of beef weighed 240 pounds and cost him 45¢ a pound. How much did the average side of beef cost the butcher? Why did he figure the weight in pounds rather than in hundredweight?

*Problems 11-17 show how the butcher cut and sold a 240-pound side of beef. Find out how much he got for each portion.*

11. Steaks, 90 lb. @ 92¢ a pound.

12. Chuck, 32 lb. @ 60¢ a pound.

13. Shoulder, 12 lb. @ 70¢ a pound.

14. Roasts, 12 lb. @ 65¢ a pound.

15. Hamburger, 20 lb. @ 54¢ lb.

16. Soup Meat, 28 lb. @ 36¢ lb.

17. Soup Bones, 16 lb. @ 15¢ lb.

18. What was the total number of pounds sold in problems 11-17? What part of the beef side was loss? Find the answer as a fraction in lowest terms.

The butcher said that his sales were about $900 per week. The meat he sold per week cost about $675. The upkeep of his store was $45 a week. He paid the meat-cutter $90 a week.

19. What was his profit per week? What part was the profit of the total sales? Find the answer as a fraction in lowest terms.

20. What part of the sales was the cost of the meat? Find this as a fraction in lowest terms.

*Find the cost of —*

21. 6 lb. round steak @ 92¢ lb.

22. $4\frac{1}{2}$ lb. chuck @ 60¢ lb.

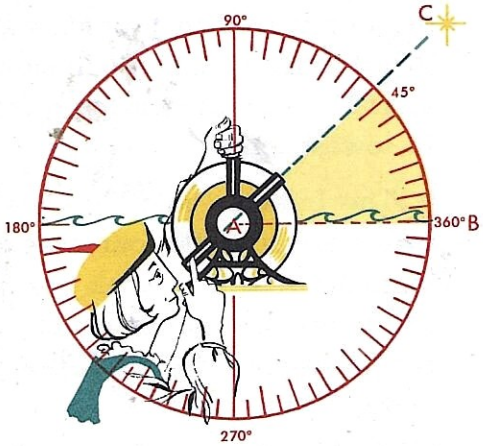
23. $6\frac{1}{4}$ lb. soup meat @ 36¢ lb.

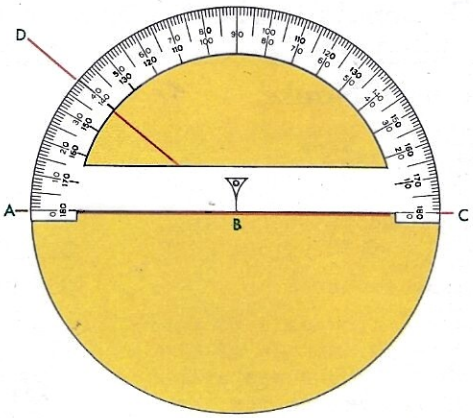
24. $2\frac{3}{4}$ lb. hamburger @ 54¢ lb.

25. A news item tells that a 4-H Club boy sold his prize steer for $13,560. The steer weighed 1130 pounds. How much per pound did the steer bring?

26. Another prize steer weighed 1200 pounds and was sold for $18,000. How much was this a pound? No pencils, please.

## Angle Measures




Five hundred years ago few ships dared to sail out of sight of land for fear of becoming lost. But two new inventions encouraged brave men like Columbus to venture out across the open seas.

The compass made it easy for sailors to keep track of directions. The other invention, the astrolabe, helped the navigator find the latitude of his ship. Latitude told him how far he was north or south of the equator.

The man in the picture is using an astrolabe. He is lining up the sight with a certain star. Later he will read the figures at the edge of the astrolabe to find out how far the star is above the horizon. With this figure the navigator can use his charts to find his latitude.

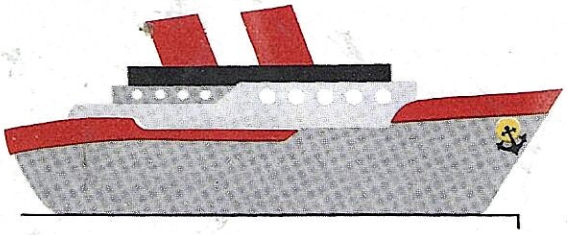
The astrolabe was used to measure the *angle* of the star; that is, it measured the opening between the lines from the navigator to the horizon *(AB)* and to the star *(AC)*.

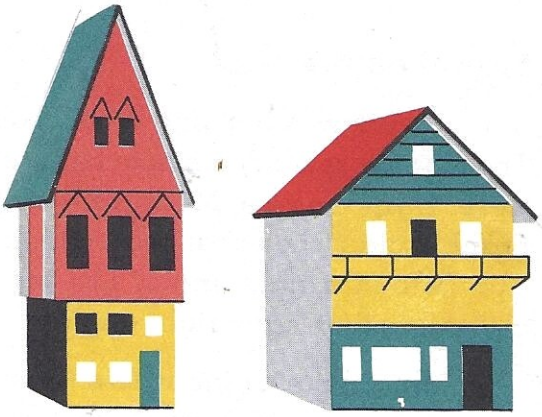
The unit of angle measure is the *degree* (°). When a whole circle around the navigator is divided into 360 equal parts (see the picture), each part is one degree. How many degrees are there in angle *BAC*?

**There are 360 degrees in a circle. One degree is $\frac{1}{360}$ of a circle.**

The tool for measuring angles drawn on paper is called a *protractor*. Since it is half a circle, it shows 180°, marked off in both directions. The degrees are marked on the protractor just as inches are marked on a ruler. The protractor in the picture shows that angle *ABD* is 40°, and that angle *CBD* is 140°.

## Measuring Angles





1. The directions in Jack's model ship-building kit said that the smokestacks should be placed at an angle of 80°. The picture above shows how Jack placed the smokestacks. Did he use the correct angle?

■ **To measure an angle,**

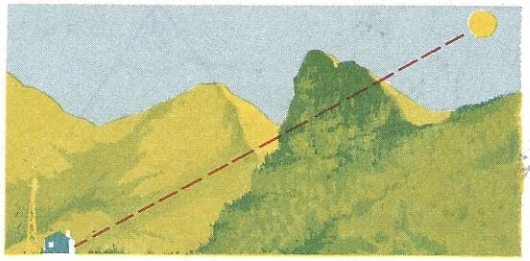
**a. Place the center of the protractor at the point where the two sides of the angle meet (vertex).**

**b. Hold a straight part of the protractor along one side of the angle.**

**c. Read the number of degrees at the point where the other side of the angle meets the curved part of the protractor.**

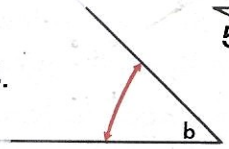
2. Mary read that the roofs of most Swiss houses are very steep so that snow will slide off easily. She read that the angle of some roofs is as much as 70°. Which drawing at the top of the page shows this type of roof?

3. Eddie lives in a mountain valley. When the sun is at an angle of 30°, as in the picture below, the house is in the shade. Will it be in the shade when the sun is at 40°? At 50°? At 60°?

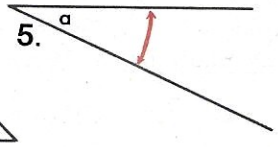


*Measure the angles below. What must you do with the sides of the angles in order to measure the angles?*

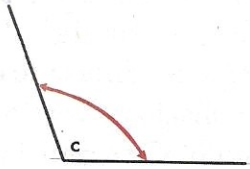
4.



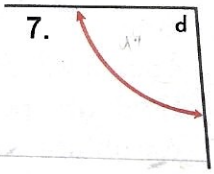

5.



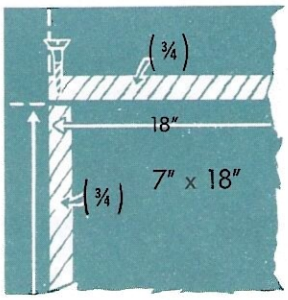

6.




7.

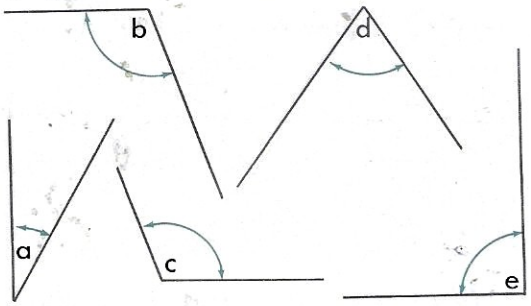


## Special Angles




1. Frank was building a bookcase in his shop class. The teacher reminded him to be sure that all his corners were *right angles*. Measure the angle in the part of Frank's plan shown at the right. How many degrees are there in a right angle? List several objects in your classroom that have right angles.

2. An *acute angle* is less than a right angle. Which angles below are acute angles? Hold two pencils together to show an acute angle. Can you think of any common objects that contain acute angles? Could the measure of an acute angle be 30°? 60°? 100°?




3. A *straight angle* contains 180°. When the teacher asked Helen to draw a straight angle on the board, Helen drew a perfectly straight line. Was she right? Why?

4. An *obtuse angle* is larger than a right angle, but smaller than a straight angle. Which angles above are obtuse angles? Hold two pencils together to show an obtuse angle. Can you think of any common objects which contain obtuse angles? Could the measure of an obtuse angle be 60°? 100°? 200°? 90°?

5. What kind of angle is formed by the hands of a clock at 3 o'clock? At 2 o'clock? At 6 o'clock? At 5 o'clock?

6. Through how many degrees does the minute hand of a clock move in one complete turn? Through how many degrees does the minute hand turn in 1 minute? In 5 minutes? In 15 minutes? In 30 minutes?

*Draw angles of the sizes given below. Have a friend measure your angles to check.*

7. 90° 180° 45° 30°

8. 60° 120° 15° 150°

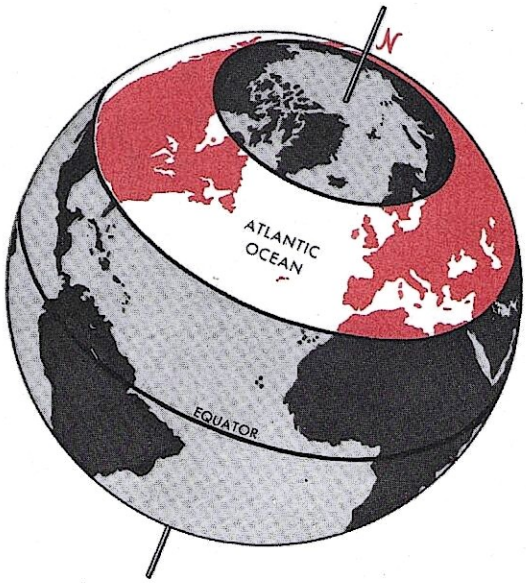
9. Place two pencils on a table to show 30°. Place two yardsticks on a table to show 30°. Does the size of the angle have anything to do with the length of the sides?

## The Sun as Timekeeper

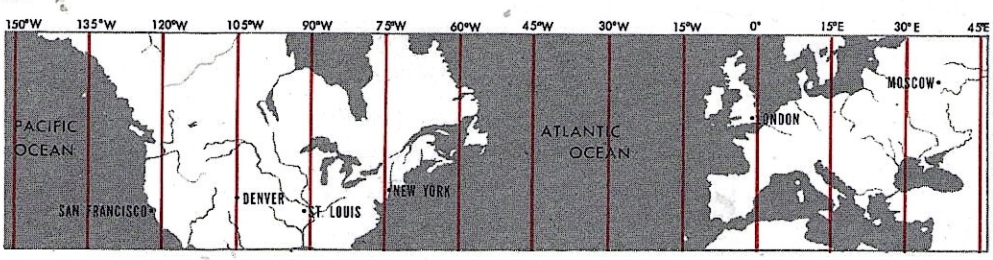
The imaginary line which passes through the North and South Poles is called the earth's axis. The earth turns on its axis once every 24 hours. It is this turning that makes day and night.

Through how many degrees does the earth move in one complete turn on its axis? Since there are 24 hours in one day, through how many degrees does the earth turn in one hour?

THINK: $360° \div 24 = \square$




Imagine that the strip of the earth's surface shown on the globe above were removed and laid flat. A part of that strip is shown in the picture below.




*Explain these statements:*

1. As the earth turns on its axis, each point on the band moves eastward through one space (15°) per hour.

2. The sun is directly overhead in London. Five hours later it is directly overhead in New York.

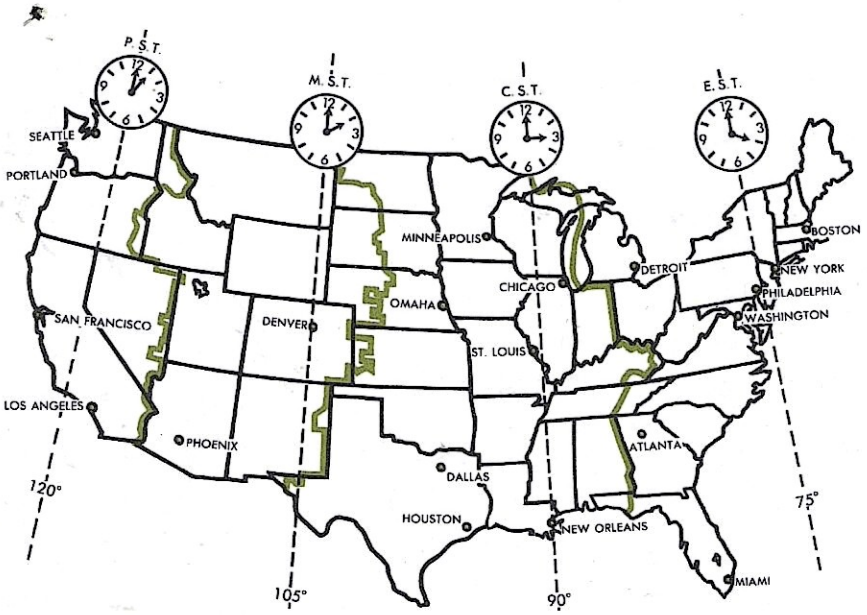
3. When it is noon in Denver, it is 2 P.M. in New York.

*Answer these questions:*

4. When it is 12 noon in London, what time is it in New York? In Moscow? In San Francisco?

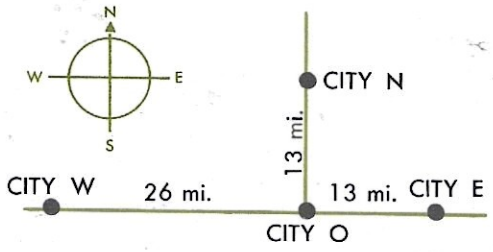
5. When it is 12 noon in New York, what time is it in London? In San Francisco? In Moscow?

6. When it is 12 noon in St. Louis, what time is it where you live?




## Standard Time

Time is figured according to the position of the sun. It is noon when the sun is directly overhead. Across the middle part of the United States the sun appears to move about 13 miles per minute.




1. If the sun is directly overhead at city O, what time is it there? How long ago was the sun overhead at E? What time is it in E now? How long will it be before the sun is directly overhead at W? What time is it in W now?

2. When it is noon in city O, what time is it in N? Why?

Many years ago the cities of the United States used sun time; that is, each city figured its own time according to the sun. As long as people stayed at home or traveled slowly from city to city, there was no difficulty. But when trains began to travel according to time schedules, there was much confusion.

In 1883, the railroads set up standard time belts to avoid this confusion. Standard time is the same throughout a time belt, and changes by one hour when you move to the next belt. The map above shows the time belts, or zones, as they are today.

The United States is divided into four Standard Time Zones:

Eastern Standard Time (EST)
Central Standard Time (CST)
Mountain Standard Time (MST)
Pacific Standard Time (PST)

**3.** It is 5 P.M., CST. What is the time, EST? MST? PST?

**4.** When it is 9 A.M. in Boston, what is the time in Pittsburgh? In Chicago? In Denver?

**5.** A television program is broadcast from New York at 10 P.M. At what hour is it seen in Baltimore? In Pittsburgh? In St. Louis? In Los Angeles?

**6.** A TV show is broadcast from Hollywood, California, at 8 P.M. At what time is it seen in Denver? In Milwaukee? In Cleveland?

**7.** Mr. Barnes flew from Denver to Chicago. His watch was correct for Denver time. How should he change it to make it correct for Chicago time?

**8.** Mr. Ball flew from St. Louis to Dallas. His watch was correct for St. Louis time. Was it correct for Dallas time?

**9.** Mr. Casey flew from Baltimore to Denver. His watch was correct for Baltimore time. How should he change his watch to make it correct for Denver time?

**10.** Mr. Rossini left Detroit by air at 6 P.M. He was in Chicago one hour later. What was the time in Chicago?

**11.** Mr. Mills left Chicago at 6 P.M. He arrived in Detroit one hour later. What was the time in Detroit?

The sun rises earlier in summer than in winter. Because of this, some communities change from Standard Time (ST) to Daylight Saving Time (DT) during the summer months. Daylight Time is 1 hour faster than Standard Time. For example, when it is 1 P.M. Standard Time, it is 2 P.M. Daylight Time.

**12.** Mr. Mills goes to work at 8 A.M. Daylight Time. What hour is it by Standard Time?

**13.** One year, Detroit did not change to Daylight Saving Time. What time was it in Chicago (CDT) when it was 4 P.M. in Detroit (EST)? What time was it in New York (EDT) when it was 4 P.M. in Detroit (EST)?

**14.** Miss Gillman arrived on a train at 2:50 P.M. Daylight Saving Time. Is she there in time to catch a train that leaves at 2 P.M. Standard Time?

## How Well Have You Learned?

*Find each answer in simplest form.*

1. Change to feet.
   18 in. $1\frac{1}{2}$ yd. 1 yd. 8 in.

2. Change to inches.
   $2\frac{1}{2}$ ft. $\frac{3}{4}$ yd. 1 ft. 9 in.

3. Change to yards.
   45 in. $1\frac{1}{2}$ ft. 4 ft. 6 in.

4. Change to minutes.
   $3\frac{1}{4}$ hr. $\frac{2}{3}$ hr. 2 hr. 15 min.

5. Change to hours.
   75 min. 2 hr. 40 min. 45 min.

6. Change to pints.
   $2\frac{1}{2}$ qt. $\frac{3}{4}$ gal. 5 qt. 1 pt.

7. Change to quarts.
   3 pt. $1\frac{1}{4}$ gal. 2 gal. 1 qt.

8. Change to gallons.
   6 pt. 12 qt. 3 qt. 1 pt.

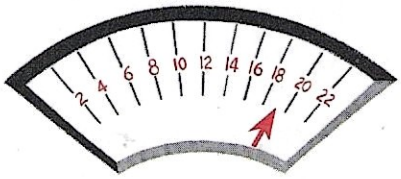
9. Change to tablespoons.
   6 tsp. $\frac{1}{2}$ c. 4 fl. oz.

10. Change to pecks.
    4 qt. $1\frac{1}{2}$ bu. 3 bu. 8 qt.

11. Change to quarts.
    5 pt. $\frac{3}{4}$ pk. 1 bu. 1 pk.

12. Change to ounces.
    $\frac{3}{4}$ lb. $1\frac{7}{8}$ lb. 2 lb. 4 oz.

13. Change to pounds.
    10 oz. 20 oz. 1 lb. 12 oz.




14. What part of a circle is represented by each of the following angles?
    90° 60° 180° 45°

*Find each answer in best form.*

15. 3 gal. 2 qt. + 5 gal. 3 qt.
    3 lb. 12 oz. + 2 lb. 8 oz.

16. 4 ft. 4 in. − 1 ft. 9 in.
    5 bu. 1 pk. − 3 bu. 3 pk.

17. 1 lb. 14 oz. × 6
    2 yd. 1 ft. × 7

18. $9\overline{)31 \text{ qt. } 1 \text{ pt.}}$
    $7\overline{)12 \text{ ft. } 3 \text{ in.}}$

19. An automobile is going 30 miles per hour. How many feet is this per minute? How many feet is this per second?

20. Mr. Harris bought 10 bu. of coal. What part of a ton is this? (Count 1 bu. of coal as 80 lb.)

21. Find the cost of 675 lb. of meat at $48 per cwt.

22. Carl drove 98 mi. in 2 hr. 20 min. How many miles per hour was this?

## Help Yourself to Improve

1. Without measuring, draw lines with these lengths:

1 ft. 8 in. 11 in. 6 in.

Now measure the lines you drew. If any line is more than 1 in. longer or shorter than the given length, erase the line and try again. (50)

*Choose the best answer.* (50)

2. An ordinary doorway is about (3, 7, 10) feet high.

3. An ordinary doorway is about (3, 6, 2) feet wide.

4. The teacher's desk is about (24, 30, 36) inches high.

5. The teacher's desk is about (24, 36, 48) inches long.

6. A farm is a square $\frac{1}{2}$ mi. on a side. About (160, 320, 640) rods of fencing are needed to go completely around the farm.

*Name the measure that does not belong with the other two.*

7. Inch; acre; foot (50)

8. Ton; pound; rod (56)

9. Quart; ounce; gallon (58)

10. Quart; peck; hundredweight (59)

11. Fluid ounce; teaspoon; ounce (61)

12. Pint; quart; peck (58)

13. Gallon; bushel; peck (59)

14. Name something that is sometimes sold by the dozen and sometimes sold by the pound. (56)

15. Name something that is sometimes sold by the bushel or peck and sometimes by the pound. (57)

16. Ronnie can walk a mile in 20 min. At this rate, how long will it take him to walk $4\frac{1}{2}$ mi.? (54)

17. At \$3.95 per 100 lb., what is the cost of $\frac{1}{2}$ T. of fertilizer? (56)

18. Henry drove his car 40 miles per hour. How many feet per minute is this? How many feet per second is this? (54)

19. Mr. Carson bought 16 bu. of coal. What part of a ton is this? (Count 1 bu. of coal as 80 lb.) (56)

20. Apples are 2 lb. for 25¢, or \$1.20 a peck. How much less per pound is it to buy apples by the peck? (Count 1 bu. as 48 lb.) (59)

21. A recipe calls for 1 fl. oz. of lemon juice. How many tablespoons will make 1 fl. oz.? (61)

22. Find the weight of 5 c. of sugar. (Count a pint of sugar as 1 lb.) (61)

23. What is the speed of a car in miles per hour if it travels 880 ft. in 10 seconds? (54)

## Show That You Know

1. Name two standard units of —

| | |
|---|---|
| Length | Liquid measure |
| Weight | Dry measure |

*Write the missing numbers.*

2. 32 in. = ☐ ft. ☐ in.
3. 36 oz. = ☐ lb. ☐ oz.
4. 10 pk. = ☐ bu. ☐ pk.
5. 10 qt. = ☐ gal. ☐ qt.
6. 11 ft. = ☐ yd. ☐ ft.
7. 40 in. = ☐ yd. ☐ in.
8. 15 pt. = ☐ qt. ☐ pt.

*Find each answer in best form.*

9. 1 ft. 9 in. + 3 ft. 7 in. ; 5 lb. 10 oz. + 3 lb. 8 oz.
10. 6 gal. 3 qt. + 2 gal. 2 qt. ; 4 yd. 4 in. + 1 yd. 10 in.
11. 5 gal. 1 qt. − 2 gal. 3 qt. ; 3 pk. − 1 pk. 3 qt.
12. 6 hr. 26 min. − 2 hr. 31 min. ; 2 T. 4 cwt. − 12 cwt.
13. 3 yd. 2 ft. × 5 ; 2 lb. 9 oz. × 6
14. 4 bu. 2 pk. × 5 ; 6 hr. 45 sec. × 4
15. 6)9 ft. 6 in. ; 7)3 lb. 15 oz.
16. 3)28 rd. 4 yd. ; 5)26 gal. 2 pt.

17. Harold drove 135 mi. in 3 hr. 45 min. How many miles per hour was this?

18. How far can you drive in 4 hr. 10 min. at an average speed of 42 miles per hour?

19. An automobile is going 45 miles per hour. How many feet per second is this?

20. A pint of sugar weighs about 1 lb. About how much does a cup of sugar weigh?

21. A pint of lard weighs about 1 lb. About how many ounces do 4 tbs. of lard weigh?

22. It is 9 A.M. by Daylight Saving Time. What is the hour by Standard Time?

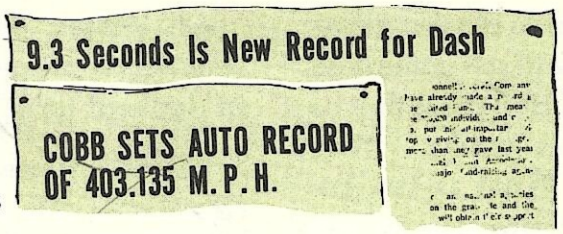
23. Which of these angles are acute? Which are obtuse?

113° 77° 90° 148° 6° 180°

24. A bushel of coal weighs about 80 lb. How many bushels of coal does it take to make a ton? How many pecks?

25. A bottle of vanilla extract is marked "1 fl. oz." How many teaspoons is this? (You may check with the table on page 61.)

26. What is the cost of 720 lb. of beef at $45 per cwt.?



Mercury Soars To 112.7 Degrees
Flood Crest Reaches High of 26.3 Feet
BOY SCOUTS REPORT 4.1 MILLION MEMBERS
Month's Rain Hits Record 13.38 Inches

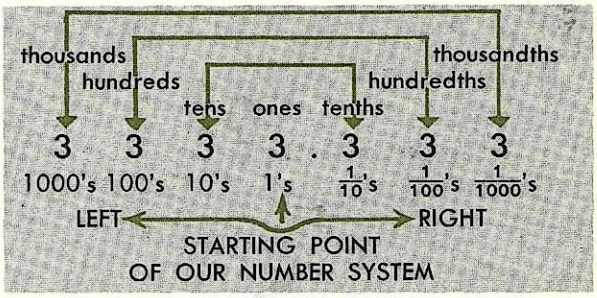
## Decimal Fractions

1. When Jim read the first headline above, he said, "Nine and three tenths seconds is new record for dash." Did he read it correctly? How did he know that there was a fraction? Write the number of seconds as a whole number and a common fraction.

2. After reading the second headline, Mary said, "The new auto record is four hundred three and one hundred thirty-five thousandths miles per hour." Was she correct? Why? Write the number in another way.

**Fractions with denominators 10, 100, or 1000 may be written with decimal points. When written with decimal points, such fractions are called decimal fractions, or decimals.**

3. The table at right shows how decimals fit into our number system. The decimal point separates the whole numbers from the fractions. Zero may be added in any decimal place which does not have a number. What do you notice when you compare the value of each 3 with the value of the 3 in the next place to the right? In the next place to the left?




| | |
|---|---|
| 3000.000 | 3 thousands |
| 300.000 | 3 hundreds |
| 30.000 | 3 tens |
| 3.000 | 3 ones |
| .300 | 3 tenths (300 thousandths) |
| .030 | 3 hundredths (30 thousandths) |
| .003 | 3 thousandths |
| 3333.333 | |

4. Read the other headlines on this page. Write each decimal number as a whole number and common fraction.

## Understanding Decimals

1. May brought to class a newspaper clipping which contained the number 12.07. She read this as "twelve and seven tenths." Why was she wrong? What is the denominator when there are figures in two places to the right of the decimal point?

2. What is the denominator when there are figures in three places to the right of the decimal point? When there is only one decimal place?

3. What is the denominator of .4278? Of .6391? Of .1436?

■ **The denominator of a decimal fraction is the name of the place in which the last figure stands.**

4. Explain why the figures below show three ways to think of decimals.

.3 = three tenths = $\frac{3}{10}$
.04 = four hundredths = $\frac{4}{100}$
.005 = five thousandths = $\frac{5}{1000}$

*Read these decimals.*

| | | | | | |
|---|---|---|---|---|---|
| 5. | .7 | .45 | .286 | .09 | .015 |
| 6. | .4 | .56 | .008 | .04 | .205 |
| 7. | .1 | .03 | .019 | .10 | .500 |
| 8. | .73 | .073 | .0073 | .906 | .096 |

9. Write nine tenths as a common fraction. As a decimal.

10. Write twenty-seven hundredths as a common fraction and in decimal form.

*Write these numbers with figures in two different ways.*

11. Four hundred twenty-five thousandths.

12. Eight tenths.

13. Eight thousandths.

14. Thirty hundredths.

15. One and forty hundredths.

16. Ninety-two and four hundred eleven thousandths.

17. Nine hundred twenty-two and sixty-one hundredths.

18. Fifty-five and five hundred five thousandths.

19. Nine and nine tenths.

20. Ninety-nine hundredths.

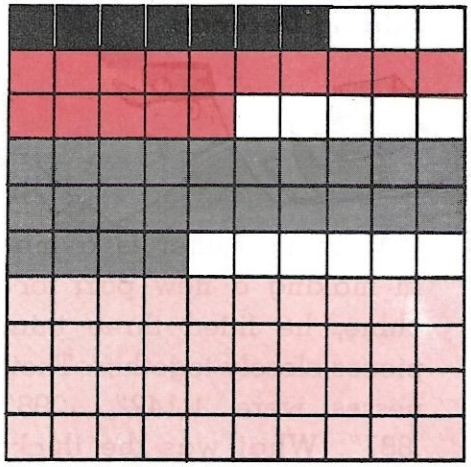
21. Ninety-nine thousandths.

▶ Some states use 1-mill tokens for payment of sales tax. A mill is equal to one tenth of one cent.

22. How many mills are equal to one cent? Write one mill as a decimal of 1¢.

23. How many mills are equal to one dollar? Write one mill as a decimal of $1.

**24.** How many small squares are there in the large square at the right? Each small square is what fraction of the large square? Write this as a common fraction and in decimal form.



**25.** What part of the large square is 15 of the small squares? Thirty of the small squares? Ninety-six? Write each of these as a common fraction and as a decimal.

**26.** What part of the large square is one row of the small squares? Write this as a decimal.

**27.** The black squares are .07 of the large square. Explain.

**28.** What part of the large square do the red squares show? The gray squares? The pink squares? Write each fraction with a decimal point.

*Choose the larger of each pair.*

| | | | | |
|---|---|---|---|---|
| **29.** | .11 | or .09 | .11 | or .9 |
| **30.** | .3 | or .29 | .30 | or .29 |
| **31.** | .08 | or .2 | .41 | or .4 |
| **32.** | .32 | or .08 | .05 | or .10 |
| **33.** | .640 | or .8 | .048 | or .4 |

**Mixed Practice**

**1.**

| | | | |
|---|---|---|---|
| 785 | 893 | 187 | 6456 |
| 450 | 67 | 208 | 993 |
| 57 | 309 | 76 | 1492 |
| 863 | 99 | 9 | 28 |
| 159 | 397 | 38 | 5487 |
| +98 | +33 | +478 | +889 |

**2.**

| | | | |
|---|---|---|---|
| $18\frac{3}{4}$ | $27\frac{1}{2}$ | $80\frac{2}{3}$ | $13\frac{4}{5}$ |
| $9\frac{1}{2}$ | $6\frac{2}{3}$ | $6\frac{1}{6}$ | $3\frac{1}{3}$ |
| $12\frac{7}{8}$ | $14\frac{5}{12}$ | $4\frac{3}{8}$ | $24\frac{7}{10}$ |
| $+5\frac{3}{16}$ | $+2\frac{5}{6}$ | $+5\frac{1}{4}$ | $+9\frac{5}{6}$ |

**3.**

| | | | |
|---|---|---|---|
| 614 | 803 | 112 | 5003 |
| −97 | −49 | −64 | −264 |

**4.**

| | | | |
|---|---|---|---|
| $12\frac{1}{2}$ | $20\frac{1}{4}$ | $15\frac{1}{6}$ | 30 |
| $-8\frac{1}{3}$ | $-6\frac{2}{3}$ | $-3\frac{3}{4}$ | $-6\frac{3}{8}$ |

**5.**

| | | | |
|---|---|---|---|
| 349 | 580 | 750 | 2400 |
| ×80 | ×25 | ×500 | ×405 |

**6.**

| | | | |
|---|---|---|---|
| $824\frac{1}{2}$ | 720 | $126\frac{7}{8}$ | 456 |
| ×48 | $\times 56\frac{1}{4}$ | ×120 | $\times 16\frac{2}{3}$ |

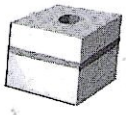
**7.** $2686 \div 34$ $\quad$ $2881 \div 67$

**8.** $9672 \div 24$ $\quad$ $6480 \div 18$

**9.** $15 \div \frac{2}{3}$ $\quad$ $36 \div 2\frac{1}{4}$

## Adding Decimals

1. Tom's father is a machinist. In making a new part for a machine, he fitted three thin metal pieces closely together. Their thicknesses were 1.142″, .098″, and .887″. What was the thickness of the new part?



$$\begin{array}{r} 1.142 \\ .098 \\ +.887 \\ \hline 2.127 \end{array}$$

■ **In adding decimals, the decimal points of all the addends must be in a straight column. The decimal point of the sum will be directly under the column of decimal points of the addends.**

*Add. Check.*

2.

| | | | |
|---|---|---|---|
| 1.48 | 8.09 | .76 | 3.124 |
| 3.26 | .67 | .81 | 1.008 |
| 1.81 | .08 | .04 | 3.605 |
| 5.73 | 1.43 | .90 | 9.762 |
| +7.04 | +7.28 | +.63 | +1.050 |

3.

| | | | |
|---|---|---|---|
| 4.38 | .99 | .43 | 8.005 |
| .83 | 3.06 | .97 | .806 |
| 1.11 | .74 | .09 | 3.830 |
| .57 | .89 | .60 | .068 |
| 4.55 | 5.65 | .87 | 4.433 |
| +9.73 | +.17 | +.04 | +.876 |

*Copy in columns and add.*

4. 7.8; 9.6; .6; 7.0; 1.3
5. 1.25; .83; 3.76; 9.19; .07
6. .325; 1.750; .789; 4.125
7. .1416; .8700; .1855; .7000

▶ In problems taken from real life, decimals used in the same problem have the same number of decimal places. If you are given an example and this is not true, you must be very careful that all decimal points are in a column. It may be helpful to annex 0's to make all addends have the same number of places.

$$\begin{array}{r} 81.6 \\ 4.05 \\ +.384 \\ \hline 86.034 \end{array} \qquad \begin{array}{r} 81.600 \\ 4.050 \\ +.384 \\ \hline 86.034 \end{array}$$

*Copy in columns and add.*

8. 4.3; .75; 9; 1.65; 12.3
9. .235; 25.6; 108; 7.29; 11.4
10. .28; .280; .028; 2.8; .028

11. Figuring with money is really figuring with decimals. Why? Add and check the following.

| | | |
|---|---|---|
| $147.50 | $475.92 | $200.02 |
| 85.75 | 103.06 | 143.27 |
| 200.00 | 75.43 | 110.00 |
| +447.18 | +3.92 | +273.99 |

## Subtracting Decimals

1. Tom's father had a piece of steel 2.039 inches thick. For a new tool he needed a piece 1.008 inches thick. How much steel did he have to remove?

$$\begin{array}{rl} 2.039 & \text{minuend} \\ -\,1.008 & \text{subtrahend} \\ \hline 1.031 & \text{difference (or remainder)} \end{array}$$

■ **In subtracting decimals, the decimal point of the subtrahend must be directly under the decimal point of the minuend. The decimal point of the answer will be directly under the other two decimal points.**

*Check by adding the difference and the subtrahend.*

| | | | | |
|---|---|---|---|---|
| 2. | 4.07 − 1.34 | 165.3 − 72.8 | 5.638 − 3.772 | 10.349 − 8.196 |
| 3. | 7.65 − 2.66 | 376.2 − 109.5 | 8.584 − 5.522 | 27.930 − 16.947 |
| 4. | 9.30 − 5.58 | 587.5 − 87.6 | 7.043 − 2.379 | 86.303 − 79.485 |
| 5. | 8.00 − 3.63 | 654.0 − 83.7 | 5.006 − 1.108 | 91.010 − 7.715 |
| 6. | 7.01 − .67 | 500.0 − 99.1 | 7.103 − 6.655 | 55.011 − 48.903 |

7. .89 − .17
8. 7.34 − 5.76
9. .73 − .28
10. 16.3 − 9.5

11. Subtract two and nine tenths from four and six tenths.

12. Subtract sixteen hundredths from forty-two hundredths.

▶ In real-life problems the minuend and subtrahend have the same number of decimal places. If you are given an example and this is not true, annex 0's where needed to make both minuend and subtrahend have the same number of places.

$$\begin{array}{rr} 4.6 & 4.60 \\ -\,1.38 & -\,1.38 \\ \hline 3.22 & 3.22 \end{array}$$

*Copy. Annex 0's where needed. Check.*

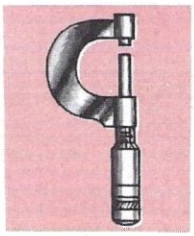
| | | | | |
|---|---|---|---|---|
| 13. | 8.75 − 4.2 | 390. − 18.6 | 6.5 − 3.285 | 31.105 − 8.9 |
| 14. | 3.2 − 1.73 | 105.3 − 9.0 | 7.11 − 3.115 | 12.02 − 9.002 |

15. Subtract six hundredths from six tenths.

*Subtract.*

16. $1.25 from $8
17. 75 cents from $2.25
18. $6 from $103.17
19. 95 cents from $10
20. Twenty cents from twenty dollars

## Careful Measuring



1. Tom's father must measure very carefully in his work as a machinist. With a special instrument called a micrometer, he can measure up to .001 of an inch. Tom's father let him bring the micrometer to class. The students used it to take careful measurements.

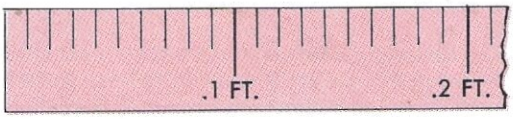
2. Tom found that each cover of his book measured .091 in. The pages of the book measured .669 in. How thick was the book in all? (Remember that there are two covers.)

3. Joe found a pencil to be .243 in. thick. After he had scraped the paint from one side, the pencil measured .242 in. How thick was the coating of paint?

4. Ann found that the thickness of a ruler was .125 in., that of a small notebook was .188 in., and that of an eraser was .625 in. What is the total thickness of all three?

5. Tom's father told him that one day he had an airplane part .0287 in. thick. To fit, it had to be .0285 in. How much did Tom's father have to cut away?

6. The picture below shows a mechanic's ruler. What part of a foot is each large division? What part of a foot is each small division?




7. Use a strip of paper 1 ft. long and 1 in. wide to make a mechanic's ruler. Mark the length of the ruler into tenths and hundredths of a foot, as in the picture. Draw lines of the following lengths:

.10 ft. .15 ft. .08 ft.

8. Measure line *a*, using only the large divisions (.1's of a foot). Is it closer to .1 or .2? Using .1 foot as the unit of measure, we can say that line *a* is ? tenths ft. long.

a. _____

b. _____

9. Measure line *b*, using .1 ft. as the unit of measure. Is it closer to .2 or .3? We would say that line *b* is ▯ ft. long.

10. What are the true measures of lines *a* and *b*? Use the small divisions on your ruler (.01 ft.).

▶ The true length of a measured length may be up to one half the unit of measure larger or smaller than the measured length. Thus, a measured length of .2 ft. means that the true length may be as little as .15 ft. and any length up to .25 ft.

**No Pencils, Please**

Remember that this means that you are not to use your pencil except to write the answers.

*Write the missing numbers.*

| | | | | |
|---|---|---|---|---|
| 1. | $\frac{1}{4}' =$ ▯ $''$ | $\frac{1}{4}$ yd. = ▯ $'$ | 2 qt. = ▯ gal. | 1 T. 500 lb. = ▯ T. |
| 2. | $\frac{1}{3}' =$ ▯ $''$ | $\frac{1}{2}$ lb. = ▯ oz. | 2 pk. = ▯ qt. | 3500 lb. = ▯ T. |
| 3. | $\frac{3}{4}' =$ ▯ $''$ | $\frac{1}{4}$ lb. = ▯ oz. | 16 pk. = ▯ bu. | $2\frac{1}{4}$ lb. = ▯ lb. ▯ oz. |
| 4. | $\frac{5}{6}' =$ ▯ $''$ | $\frac{3}{4}$ lb. = ▯ oz. | 16 qt. = ▯ pk. | 3 lb. 8 oz. = ▯ lb. |
| 5. | $1\frac{1}{2}' =$ ▯ $''$ | $\frac{1}{8}$ lb. = ▯ oz. | 1 bu. = ▯ qt. | 5 pt. = ▯ qt. ▯ pt. |
| 6. | $1\frac{2}{3}' =$ ▯ $''$ | $\frac{5}{8}$ lb. = ▯ oz. | 28 in. = ▯ ft. | 10 qt. = ▯ gal. ▯ qt. |
| 7. | $\frac{1}{2}$ yd. = ▯ $''$ | 12 oz. = ▯ lb. | 1 rd. = ▯ yd. | 10 qt. = ▯ pk. ▯ qt. |
| 8. | $\frac{1}{3}$ yd. = ▯ $''$ | 16 oz. = ▯ lb. | 20 rd. = ▯ yd. | 3 bu. 2 pk. = ▯ pk. |
| 9. | $\frac{3}{4}$ yd. = ▯ $''$ | 20 oz. = ▯ lb. | 1 rd. = ▯ ft. | 1 pt. = ▯ fl. oz. |
| 10. | $\frac{1}{6}$ yd. = ▯ $''$ | $\frac{1}{2}$ T. = ▯ lb. | 10 rd. = ▯ ft. | 1 c. = ▯ fl. oz. |
| 11. | $\frac{5}{6}$ yd. = ▯ $''$ | $\frac{3}{8}$ T. = ▯ lb. | 1 mi. = ▯ rd. | 1 c. = ▯ tbs. |
| 12. | $\frac{1}{8}$ yd. = ▯ $''$ | 8 pt. = ▯ qt. | $\frac{1}{4}$ mi. = ▯ rd. | 1 fl. oz. = ▯ tbs. |
| 13. | $\frac{1}{3}$ yd. = ▯ $'$ | 3 qt. = ▯ pt. | 160 rd. = ▯ mi. | 1 tbs. = ▯ tsp. |
| 14. | $\frac{2}{3}$ yd. = ▯ $'$ | 8 pt. = ▯ gal. | 36 oz. = ▯ lb. | 24 fl. oz. = ▯ pt. |
| 15. | $\frac{1}{2}$ yd. = ▯ $'$ | $1\frac{1}{2}$ gal. = ▯ qt. | 500 lb. = ▯ T. | 1 fl. oz. = ▯ tsp. |

## Multiplying Decimals

1. Joy watched a TV weather report which told that it had snowed every day for 12 days and that an average of 1.2 inches had fallen per day. Joy was very much surprised that (according to her figuring) it had snowed 144 inches in 12 days. Was she correct? What had she forgotten?

Joy's father told her that her answer was not sensible. He told her to estimate her product before multiplying.

THINK: 1.2 in. = about 1 in.
$12 \times 1 = 12$
$12 \times 1.2$ = about 12

Which of these would be a sensible product? 14.4 in., 1.44 in.

2. Multiply 6.8 by 2.3.

THINK: 2.3 may be rounded to 2
6.8 may be rounded to 7
$2.3 \times 6.8$ is near ?

3. Multiply .521 by 16.

THINK: .521 is near .500 or $\frac{1}{2}$

*Estimate products. Multiply as with whole numbers, but write decimal points in the answers.*

| | | | | |
|---|---|---|---|---|
| 4. | 7.21 ×6 | 18.03 ×5 | .763 ×8 | .509 ×6.4 |
| 5. | 6.89 ×4.8 | 23.94 ×2.8 | .494 ×7.8 | .259 ×24 |
| 6. | 9.32 ×21 | 54.78 ×7.9 | .335 ×12 | .896 ×2.5 |

7. Knowing how to multiply common fractions will help you learn where to place decimal points when multiplying decimals. What is $.3 \times .7$ ?

THINK: $\frac{3}{10} \times \frac{7}{10} = \frac{21}{100} = .??$

*Multiply as common fractions and as decimals.*

8. $.3 \times .9$ $.3 \times .23$ $.7 \times .9$

9. $.7 \times .31$ $.17 \times .23$ $.63 \times .57$

■ **In multiplying decimals, there are as many decimal places in the product as in the multiplicand and the multiplier together.**

*Multiply. Place the decimal points correctly. Be sure that every product is sensible.*

| | | | | |
|---|---|---|---|---|
| 10. | 38.5 ×1.7 | 96.14 ×3.8 | .387 ×4.3 | 7.58 ×.5 |
| 11. | 72.5 ×6.4 | 8.384 ×5.2 | 9.63 ×.44 | 2.98 ×.05 |
| 12. | 8.83 ×.25 | 623.9 ×1.2 | .664 ×2.5 | .97 ×53 |

*Multiply. Think whether the product is sensible.*

13. $10 \times 2\frac{1}{2}$ $10 \times 2.5$
14. $20 \times 2\frac{1}{4}$ $20 \times 2.25$
15. $12 \times 3\frac{3}{4}$ $12 \times 3.75$
16. $16 \times 3\frac{1}{8}$ $16 \times 3.125$
17. $24 \times 5\frac{5}{8}$ $24 \times 5.625$
18. $32 \times 1\frac{7}{8}$ $32 \times 1.875$

*Which number in parentheses is sensible for the product?*

19. $6.9 \times 2.9$ (2.001; 20.01; 200.1)
20. $.31 \times 7.3$ (2.263; 22.63; 226.3)
21. $.77 \times .31$ (.2387; 2.387; 23.87)
22. $225 \times .08$ (.1800; 18.00; 180.0)

23. What is the cost of 12 cans of pet food at \$.17 a can? Is your answer sensible?

24. What is the cost of 24 cans of dog food at \$.09 a can?

*Multiply. Think whether the product is sensible.*

25. \$.39 $\times 24$ \$.07 $\times 32$ \$135.67 $\times 18$

26. \$1.26 $\times 72$ \$2.88 $\times 2\frac{1}{2}$ \$2.88 $\times 2.5$

Jane's father works for the electric company. He gave her a folder which listed the average costs of operating various electrical appliances.

| AVERAGE MONTHLY COST OF OPERATION | | | |
|---|---|---|---|
| Refrigerator | \$1.49 | Radio | \$ .20 |
| Coffeemaker | .20 | TV (21″) | 1.18 |
| Toaster | .07 | TV (17″) | .88 |
| Clock | .04 | Washer | .10 |
| Vacuum Cleaner | .04 | Iron | .25 |

27. In addition to the first four appliances listed above, Jane's mother has a radio in her kitchen. What will it cost to operate all five for a month? For a year?

28. What will it cost to operate the two laundry appliances for one month? For one year? For 5 years?

29. Bob's parents bought a new 21″ TV set. How much more will it cost per month to operate this set than their old 17″ set? How much more per year?

30. Ray said that it costs about six times as much to operate a 21″ TV set as a radio. Was he right? Explain.

31. An appliance salesman told Mrs. Jay that it would cost about \$2.00 to operate a certain vacuum cleaner for 5 years. How much more or less was this than the cost listed above?

## Rounding Decimals

Jill's father bought 2.3 gallons of gasoline for his lawn mower at 29.9¢ per gallon. He paid 69¢. Jill figured that the exact cost was 68.77 cents. What had been done to the number?

*Explain the rounding below.*

| | Rounded to the nearest — | | |
|---|---|---|---|
| | hundredth | tenth | whole number |
| 8.537 | 8.54 | 8.5 | 9 |
| 6.296 | 6.30 | 6.3 | 6 |
| 7.052 | 7.05 | 7.1 | 7 |

1. Round these decimals to the nearest hundredth; to the nearest tenth; to the nearest whole number:

4.382 8.501 7.6293 3.3767

*Round answers to tenths.*

2.

| | | | |
|---|---|---|---|
| .09 | .543 | 1.90 | .065 |
| .93 | 4.006 | .95 | .115 |
| .40 | .627 | 5.32 | .468 |
| +.28 | +5.332 | +4.49 | +.135 |

3.

| | | | |
|---|---|---|---|
| .51 | 7.504 | 5.32 | .549 |
| −.33 | −1.888 | −.65 | −.083 |

4.

| | | | |
|---|---|---|---|
| .64 | 3.427 | 9.34 | .427 |
| ×8 | ×.6 | ×4.8 | ×.9 |

## Short Cuts in Multiplication

1. A committee counted the seats in the auditorium to see how many people could be invited to a class program. There were 24 rows with 10 seats in each row. Fay said immediately that there were 240 seats. What short cut did she use for multiplying by ten?

2. What is the short-cut rule for multiplying a whole number by 100? By 1000?

3. Multiply each number below by 10. By 100. By 1000.

32 6 .9 .02 .006 .0004

What happened to the decimal point in the decimals? Where would you place the decimal point in a whole number?

■ **When you multiply a decimal by 10, move the decimal point one place to the right.**

4. Make a rule for multiplying a decimal by 100. By 1000.

*Write answers only.*

5. 10×1.4 100×3.25 1000×3.78

6. 10×837 100×15.3 1000×.874

## Dividing Decimals

1. A hobby shop had a sale on all model airplane kits. Jack bought 5 large kits for $10.00. What was the cost of each kit?

2. At the same sale, Jerry paid $4.29 for three small model airplane kits. What was the cost of each kit that Jerry bought?

Where does the decimal point belong?

$$5\overline{)\$10.00} \quad \$\,2\,0\,0$$

THINK: $10 ÷ 5 equals 2 whole dollars.

$$3\overline{)\$4.29} \quad \$1\,4\,3$$

THINK: $4 ÷ 3 equals 1 whole dollar and a remainder.

■ **To divide a decimal by a whole number,**

**a. Divide as if the dividend were a whole number.**

**b. Write the decimal point in the quotient directly above the decimal point in the dividend.**

3. Arthur paid $.72 for 12 pencils. What was the price per pencil? Is your answer sensible?

4. Divide .72 by 12. Check by multiplying.

*Divide. Check by multiplying.*

| | | |
|---|---|---|
| 5. | 14.4 ÷ 12 | 1.728 ÷ 12 |
| 6. | 1.21 ÷ 11 | 10.24 ÷ 32 |
| 7. | .512 ÷ 8 | 139.2 ÷ 24 |
| 8. | 4.03 ÷ 13 | 5.409 ÷ 9 |
| 9. | 43.7 ÷ 23 | 54.53 ÷ 41 |
| 10. | .667 ÷ 29 | 592.1 ÷ 31 |
| 11. | 6.97 ÷ 17 | .5713 ÷ 29 |
| 12. | 76.7 ÷ 13 | 7.261 ÷ 53 |

13. Bob bought some wire which weighed 24 oz. He was told that the wire weighs 4.8 oz. per yard. How many yards did he buy?

*Round to whole numbers and choose sensible quotients.*

14. 37.8 ÷ 6.4 (.6 6 60)

15. 6.23 ÷ 8.9 (.7 7 70)

16. 28.8 ÷ 7.2 (.4 4 40)

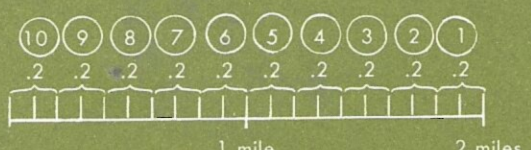
17. Which is the larger, $\frac{1}{2}$ or $\frac{10}{20}$? $\frac{3}{4}$ or $\frac{300}{400}$? $\frac{8}{2}$ or $\frac{80}{20}$?

Is the value of a fraction changed when both numerator and denominator are multiplied by the same number?

18. Divide: $2\overline{)8}$ $20\overline{)80}$ $200\overline{)800}$

Is the value of a quotient changed when both divisor and dividend are multiplied by the same number?

## Dividing by Tenths




1. $2.0 - .2 = 1.8$
2. $1.8 - .2 = 1.6$
3. $1.6 - .2 = 1.4$
4. $1.4 - .2 = 1.2$
5. $1.2 - .2 = 1.0$
6. $1.0 - .2 = .8$
7. $.8 - .2 = .6$
8. $.6 - .2 = .4$
9. $.4 - .2 = .2$
10. $.2 - .2 = 0$

1. By using the speedometer on his bicycle and his watch, Mike found that at ordinary speed he traveled about .2 mile a minute. How long would it take him to ride his bicycle 2 miles? Explain Mike's drawing and figuring in the picture. Could he have found this answer by adding? How?

2. Find how many .2's equal 2 by changing both numbers to $\frac{1}{10}$'s.

THINK: $.2 = \frac{2}{10}$; $2 = \frac{20}{10}$

$$2 \div .2 = \frac{20}{10} \div \frac{2}{10} = 20 \div 2 = \blacksquare$$

3. Is 20 tenths ÷ 2 tenths equal to 20 ÷ 2? By what number can 2 be multiplied to change it to 20? By what number can .2 be multiplied to change it to 2?

4. When .2 is multiplied by 10, to what kind of number is it changed? What is the short-cut way to multiply .2 by 10?

5. To find $7.2 \div .4$, Tom thought of the division as a fraction with the numerator 7.2 and the denominator .4. What did he do to change the fraction to $\frac{72}{4}$?

$$\frac{7.2}{.4} = \frac{7.2 \times 10}{.4 \times 10} = \frac{72}{4} = \blacksquare \overline{)72}$$

6. Larry had a sheet of copper 4.5 inches wide. He wanted to cut it into strips 1.5 inches wide. How many strips will he have?

THINK: $1.5\overline{)4.5} = 15\overline{)45}$

■ **To divide by tenths written as a decimal, multiply both the divisor and the dividend by 10 so that you have a whole number for a divisor.**

*Divide.*

| | | | |
|---|---|---|---|
| 7. | $.4\overline{)9.2}$ | $6.4\overline{)3.84}$ | $3.1\overline{)406.1}$ |
| 8. | $.6\overline{)7.2}$ | $7.2\overline{)50.4}$ | $4.1\overline{)42.23}$ |
| 9. | $.8\overline{).56}$ | $5.2\overline{).468}$ | $4.7\overline{)4.371}$ |
| 10. | $.9\overline{).54}$ | $4.7\overline{)4.23}$ | $3.7\overline{).4699}$ |
| 11. | $.7\overline{)63}$ | $3.6\overline{)25.2}$ | $4.7\overline{)51.23}$ |
| 12. | $.5\overline{)75}$ | $8.3\overline{).747}$ | $4.3\overline{).5633}$ |
| 13. | $.8\overline{)7.2}$ | $7.2\overline{)3.6}$ | $3.6\overline{)1.728}$ |

## Dividing with Decimals

1. Harry spent \$1.47 for candy for a party. The candy cost \$.21 a bag. How many bags did he buy? Explain why the quotients are the same in both divisions below.

$$\begin{array}{r} 7 \\ \$.21\overline{)\$1.47} \end{array} \qquad \begin{array}{r} 7 \\ 21¢\overline{)147¢} \end{array}$$

2. One kind of ball bearing weighs .21 ounce. How many of these ball bearings will weigh a total of 1.47 ounces? Complete both divisions below. Are both quotients the same? Why?

$$\begin{array}{r} \square \\ .21\overline{)1.47} \end{array} \qquad \begin{array}{r} \square \\ 21\overline{)147} \end{array}$$

*Divide. Explain each step.*

3. $.23\overline{)2.07}$ $.46\overline{)3.68}$

4. $.71\overline{)49.7}$ $.92\overline{)55.2}$

5. $1.24\overline{)7.44}$ $3.18\overline{)22.26}$

6. Pete felt that it took too long to copy the divisions after multiplying the divisor and dividend by 10 or 100. Instead, he moved the decimal point to the right by drawing a curved arrow. He placed the decimal point in his quotient above the new decimal point in the dividend.

$2.8\overline{)1.96} = 28\overline{)19.6}$ $2.8\overline{)1.96}$

7. A caret ( $\wedge$ ) is easier to make than the curved arrow which Pete used. It shows where the new decimal points are after the divisor and dividend have been multiplied by 10, 100, or 1000. Complete the examples below.

$4.3\wedge\overline{)2.1\wedge5}$ $.028\wedge\overline{)2.520\wedge}$

■ **To use a short cut in dividing by tenths,**

a. **Move the decimal points in both the divisor and the dividend one place to the right to show that you have multiplied both by 10.**
b. **Place carets to show where the new decimal points are.**
c. **Divide as with whole numbers.**
d. **Place the decimal point in the quotient over the new decimal point in the dividend.**

8. Make up a short-cut rule for dividing by hundredths. By thousandths.

*Use the short-cut method.*

9. $2.3\overline{)188.6}$ $2.4\overline{)19.44}$

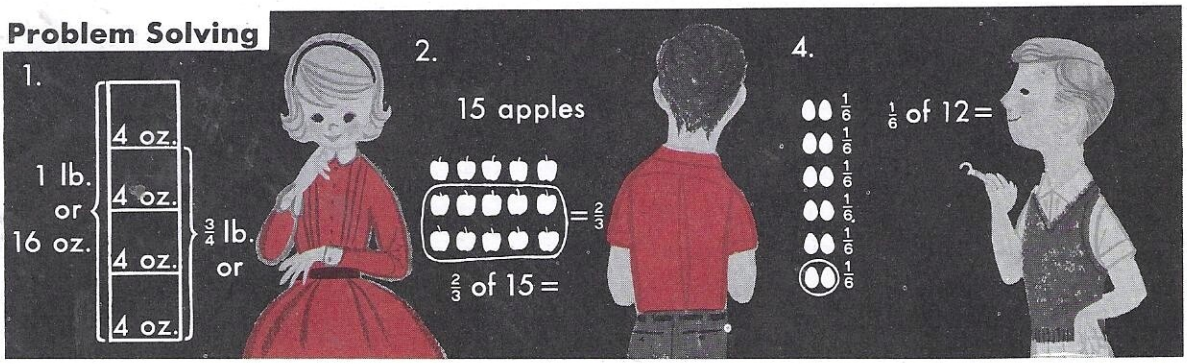
10. $2.6\overline{)1.612}$ $3.6\overline{).2628}$

11. $.34\overline{)29.58}$ $.57\overline{).4617}$

12. $.46\overline{)3.864}$ $.053\overline{)4.134}$

13. $.043\overline{)28.81}$ $.048\overline{).3984}$

## Problem Solving




Making a drawing for a problem often makes it easier to work. If you can draw a problem, you can usually work it.

The students in the picture above made drawings for some of the problems on this page and the next page. Copy or finish their drawings as you work each problem. Make your own drawing for those problems which are not in the picture.

**1.** Helen bought $\frac{3}{4}$ lb. of sausage. How many ounces was this?

**2.** Mary had 15 apples and gave $\frac{2}{3}$ of them away. How many did she give away?

**3.** Jack had 12 boxes of berries in his roadside stand. If he sold $\frac{2}{3}$ of them, how many boxes did he sell?

**4.** Julia had a dozen eggs and accidentally dropped two of them. What fraction of the eggs did she drop?

**5.** Frank has 16 stamps from Japan. Ten of them he received from his uncle, who is in Japan. What part of the stamps came from his uncle?

**6.** Mrs. Jones bought 30 ft. of clothesline. Her son Alan used 18 ft. for a line in the basement. What part of the line did he use?

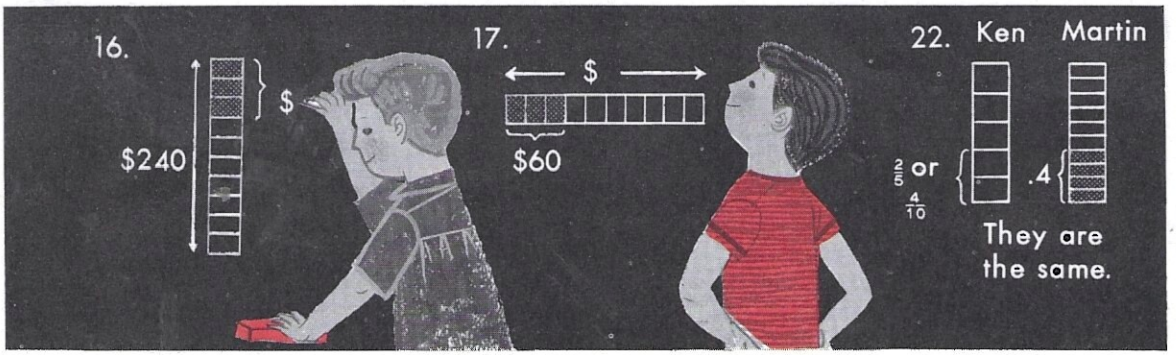
**7.** Dick spent $4. This was $\frac{1}{3}$ of the money he had received for his birthday. How much did he receive?

**8.** Jane spent $4. This was $\frac{2}{5}$ of her birthday present. How much did she receive for her birthday?

**9.** Jay sold 12 rabbits. This was $\frac{3}{4}$ of his whole stock. How many rabbits did Jay have before he sold any?

**10.** Oscar sold a knife for 75¢. His profit was $\frac{1}{4}$ of the cost of the knife. How much had the knife cost?

**11.** How many cherries were




there in a bowl if the 12 cherries which Tom took were (a) $\frac{2}{3}$ of all the cherries? (b) $\frac{3}{4}$ of all the cherries? (c) $\frac{2}{5}$ of all? (d) $\frac{3}{8}$ of all?

Four members of a committee read pamphlets for a history report. What part of his pamphlet had each student read when he had read 24 pages, if the lengths of the pamphlets were the following?

**12.** Tim's pamphlet — 30 pages

**13.** Dan's pamphlet — 48 pages

**14.** Vic's pamphlet — 32 pages

**15.** Tom's pamphlet — 60 pages

**16.** Of the $240 Alice earned one month, she used .3 for clothes. How much money did she spend for clothes?

**17.** If Alice spends .3 of her earnings for clothes, how much must she earn to have $60 for clothes?

**18.** Paul earned $28 one month delivering papers. He decided to use .2 of his earnings for a birthday present for his mother. How much did he spend for the present?

**19.** Marilyn heard on television that an average of only .7 of all the voters had voted in an election. How many people are there in a district where (a) 63 people voted? (b) 350 voted? (c) 84 voted? (d) 210 voted?

**20.** There are 750 students in a school. What part (decimal) of them voted in a school election if (a) 600 students voted? (b) 450 voted? (c) 375 voted? (d) 675 voted?

**21.** Clyde sells magazines. He gets to keep $\frac{3}{8}$ of all the money he collects. How much did he collect when his part was (a) $6? (b) $4.50? (c) $7.20? (d) $9?

**22.** Ken lives $\frac{2}{5}$ mile from school and Martin lives .4 mile from school. Who lives the greater distance from the school? Why?

## Changing Fractions to Decimals

1. Bob lives $\frac{1}{2}$ mile from school and Harold lives .6 mile from school. Who lives the greater distance from the school?

It is easy to change some common fractions to equivalent fractions with denominators 10 or 100 or 1000. It is simple to change such fractions to decimals. Study and explain the examples at the right.

$$\frac{1}{2}=\frac{1\times5}{2\times5}=\frac{5}{10}=.5$$

$$\frac{4}{5}=\frac{4\times2}{5\times2}=\frac{8}{10}=.8$$

$$\frac{3}{4}=\frac{3\times25}{4\times25}=\frac{75}{100}=.75$$

$$\frac{5}{8}=\frac{5\times125}{8\times125}=\frac{625}{1000}=.625$$

2. Change these fractions to equivalent fractions with denominators 100 or 1000. Then write the changed fractions in decimal form. $\frac{1}{4}$ $\frac{3}{8}$ $\frac{7}{8}$ $\frac{3}{4}$

3. Study the examples at the right. How were these common fractions changed to decimals? Why is this an easy way to change common fractions to decimals?

$$\frac{1}{2}=2\overline{)1.0}\quad .5$$

$$\frac{3}{4}=4\overline{)3.00}\quad .75$$

$$\frac{5}{8}=8\overline{)5.000}\quad .625$$

■ **To change a common fraction to a decimal, divide the numerator of the fraction by its denominator.**

4. Change to decimals. Use the division method.

$\frac{3}{4}$ $\frac{2}{5}$ $\frac{3}{5}$ $\frac{7}{8}$ $\frac{3}{10}$

5. John tried to use the division method to change $\frac{1}{3}$ to a decimal. He found that it did not come out to be an even decimal. What did he do to his decimal? Does $\frac{1}{3}$ equal *exactly* .333?

$$\frac{1}{3}=3\overline{)1.000}\quad .333\tfrac{1}{3}=.333$$

■ **When changing a common fraction to a decimal, it may be desirable to round the decimal to the nearest tenth, hundredth, or thousandth.**

6. Change to decimals. Round to hundredths.

$\frac{1}{6}$ $\frac{5}{6}$ $\frac{5}{12}$ $\frac{7}{12}$ $\frac{9}{16}$

7. Change to decimals. Round to thousandths.

$\frac{2}{3}$ $\frac{4}{9}$ $\frac{15}{32}$ $\frac{7}{16}$ $\frac{2}{7}$

8. Explain how these mixed numbers were changed.

$6\frac{1}{4}=6.25$ $1\frac{7}{8}=1.875$

*Change to decimals. Round to thousandths those which do not come out exactly.*

| | | | | | |
|---|---|---|---|---|---|
| 9. | $4\frac{1}{2}$ | $6\frac{1}{4}$ | $3\frac{3}{4}$ | $3\frac{1}{5}$ | $5\frac{2}{5}$ |
| 10. | $1\frac{3}{8}$ | $4\frac{5}{8}$ | $7\frac{7}{8}$ | $7\frac{3}{5}$ | $1\frac{4}{5}$ |
| 11. | $2\frac{3}{10}$ | $6\frac{2}{3}$ | $7\frac{1}{8}$ | $2\frac{5}{6}$ | $3\frac{1}{7}$ |
| 12. | $8\frac{1}{3}$ | $3\frac{1}{6}$ | $3\frac{9}{10}$ | $4\frac{1}{12}$ | $9\frac{3}{16}$ |

**13.** The equivalents in the table at right are often used. Prove that they are equal. You will save much time later if you will learn them from memory.

| | | |
|---|---|---|
| $\frac{1}{3}=.33\frac{1}{3}$ | $\frac{1}{8}=.12\frac{1}{2}$ | $\frac{2}{5}=.4$ or $.40$ |
| $\frac{2}{3}=.66\frac{2}{3}$ | $\frac{3}{8}=.37\frac{1}{2}$ | $\frac{3}{5}=.6$ or $.60$ |
| $\frac{1}{4}=.25$ | $\frac{5}{8}=.62\frac{1}{2}$ | $\frac{4}{5}=.8$ or $.80$ |
| $\frac{3}{4}=.75$ | $\frac{7}{8}=.87\frac{1}{2}$ | $\frac{1}{10}=.1$ or $.10$ |
| $\frac{1}{6}=.16\frac{2}{3}$ | $\frac{1}{2}=.5$ or $.50$ | $\frac{3}{10}=.3$ or $.30$ |
| $\frac{5}{6}=.83\frac{1}{3}$ | $\frac{1}{5}=.2$ or $.20$ | $\frac{7}{10}=.7$ or $.70$ |

**14.** It is easy to change decimals to common fractions because decimals are fractions with denominators such as 10, 100, or 1000. Change these decimals to common fractions: .3; .9; .1; .17; .23.

$.7=\frac{7}{10}$ $.07=\frac{7}{100}$ $.007=\frac{7}{1000}$

■ **To change a decimal to a common fraction, write the decimal with a denominator instead of a decimal point. The denominator will end with as many zeros as there are decimal places in the decimal.**

**15.** When a decimal is changed to a fraction, the fraction may need to be changed to lowest terms. Complete and explain:

$.5=\frac{5}{10}=\frac{?}{?}$ $.75=\frac{75}{100}=\frac{?}{?}$

$.375=\frac{375}{1000}=\frac{?}{?}$

*Change to common fractions.*

**16.** .6 .8 .24 .35 .125

**17.** .5 .25 .75 .16 .375

**18.** When a decimal contains a fraction, we usually get rid of the fraction. Study and explain each step below.

$$.62\tfrac{1}{2}=\frac{62\frac{1}{2}}{100}=\frac{62\frac{1}{2}\times 2}{100\times 2}=\frac{125}{200}=\frac{5}{8}$$

$$.33\tfrac{1}{3}=\frac{33\frac{1}{3}}{100}=\frac{33\frac{1}{3}\times 3}{100\times 3}=\frac{100}{300}=\frac{1}{3}$$

*Change to common fractions.*

**19.** $.12\frac{1}{2}$ $.37\frac{1}{2}$ $.87\frac{1}{2}$ $.08\frac{1}{3}$

**20.** $.16\frac{2}{3}$ $.66\frac{2}{3}$ $.06\frac{1}{4}$ $.31\frac{1}{4}$

**21.** $.83\frac{1}{3}$ $.41\frac{2}{3}$ $.58\frac{1}{3}$ $.06\frac{2}{3}$

**22.** $.56\frac{1}{4}$ $.43\frac{3}{4}$ $.68\frac{3}{4}$ $.93\frac{3}{4}$

*Give fractional equivalents.*

**23.** .50 .25 .75 .30

**24.** $.16\frac{2}{3}$ $.33\frac{1}{3}$ $.66\frac{2}{3}$ $.12\frac{1}{2}$

**25.** .80 .02 .05 .15

**26.** $.37\frac{1}{2}$ $.87\frac{1}{2}$ $.62\frac{1}{2}$ $.83\frac{1}{3}$

*Give decimal equivalents.*

**27.** $\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{3}$ $\frac{1}{6}$

**28.** $\frac{3}{5}$ $\frac{3}{8}$ $\frac{5}{8}$ $\frac{7}{8}$

**29.** $\frac{1}{8}$ $\frac{2}{3}$ $\frac{3}{4}$ $\frac{1}{5}$

**30.** $\frac{1}{10}$ $\frac{3}{10}$ $\frac{9}{10}$ $\frac{3}{25}$

## Money Numbers as Decimals

1. A class planned a trip to the museum. Each student agreed to bring \$.25 to help pay the cost of a chartered bus. If there were 32 students in the class, how much would they have? A short way of multiplying makes use of the equivalents on page 89.

THINK: $\$.25 = \$\frac{1}{4}$ $32 \times \$\frac{1}{4} = \$$ ?

2. What is the cost of 12 milk shakes at \$.25 each?

3. School pins are $62\frac{1}{2}¢$ each when bought in lots of a dozen. What is the cost of a dozen pins?

THINK: $62\frac{1}{2}¢ = \$.62\frac{1}{2} = \$$ ?

4. School caps are $66\frac{2}{3}¢$ each when bought in dozen lots. What is the cost of three dozen caps?

5. Change to decimals of a dollar: $\$\frac{2}{5}$; $\$\frac{3}{8}$; $\$\frac{4}{5}$; $\$\frac{1}{8}$.

6. Change to fractions of a dollar: \$.60; $\$.33\frac{1}{3}$; \$.25; $\$.87\frac{1}{2}$.

7. Write each of the common coins (half dollar, quarter, dime, nickel, and cent) as a decimal of a dollar and as a fraction of a dollar.

*Use the quickest method to find these products.*

8. $35 \times \$.60$ $40 \times \$.05$ $30 \times \$.66\frac{2}{3}$

9. $15 \times \$.40$ $25 \times \$.20$ $48 \times \$.16\frac{2}{3}$

10. $18 \times \$.50$ $36 \times \$.75$ $60 \times \$.33\frac{1}{3}$

11. $48 \times \$.25$ $45 \times \$.80$ $72 \times \$.12\frac{1}{2}$

12. School sweaters are $\$3.33\frac{1}{3}$ each when bought in dozen lots. What is the cost of a dozen?

THINK: $\$3.33\frac{1}{3} = \$3\frac{1}{3}$
$12 \times \$3\frac{1}{3} = \$$ ?

13. What is the cost of 16 books at \$1.25 each?

14. What is the cost of a dozen T-shirts at $\$1.66\frac{2}{3}$ each?

15. Tim helped his father in his candy store. He packed caramels in bags, 25 to the bag. How many would he need to fill 16 bags?

Tim added 2 zeros to the 16 and divided by 4. He said that he would need 400 caramels. Was he right? Explain how he figured.

■ **A short way to multiply by 25 is to multiply by 100 and divide by 4.**

16. Multiply each number by 25.

488 208 448 4.48 .32

17. Make a rule for a short way to multiply by $33\frac{1}{3}$. Multiply each number by $33\frac{1}{3}$.

3 336 27 366 3.66

## Dividing by 10, 100, and 1000

1. While working in the library, Dorothy stacked books in piles of 10. How many piles did she make of 130 books? What do you notice when you compare the quotient with the dividend in A, below?

A. $10\overline{)130}$ $13$ B. $100\overline{)1100}$ $11$

2. Dorothy placed 100 books in each small bookcase. How many cases could she fill with 1100 books? What do you notice when you compare the quotient with the dividend in B, above?

3. Make a rule for dividing a number by 10. By 100. By 1000.

4. John worked for a newspaper distributor. He counted out newspapers in piles of ten for the delivery boys. How many piles could he make from 98 papers? What do you notice when you try to use the rule for dividing by 10?

Think of a decimal point as being at the end of a whole number. (Thus, $98 = 98.0$) What do you notice when you compare the quotient (9.8) with the dividend (98.0)?

$10\overline{)98.0}$ $9.8$

5. Compare the quotients with the dividends when you divide these by 10: .6; .25; .375; 25.47.

■ **To divide any number by 10, move the decimal point of the number one place to the left.**

*Use the rule to divide by 10. Write answers only. Is each answer sensible?*

| | | | | | |
|---|---|---|---|---|---|
| 6. | 40 | 54 | .3 | 4.2 | 14.7 |
| 7. | 600 | 8 | .05 | 6.25 | .034 |
| 8. | 280 | 125 | .025 | 18.3 | 183.5 |

9. Make a rule for dividing any number by 100. Use the rule to divide the numbers in row 6, above.

10. Make a rule for dividing any number by 1000. Use the rule to divide the numbers in row 7, above.

11. A farmer sowed 2000 lb. of grass seed on 100 acres of land. This was ? pounds per acre.

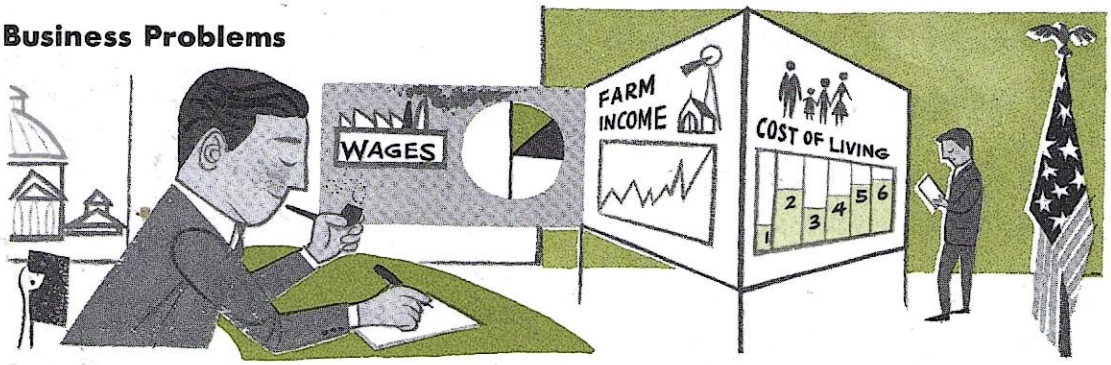
12. A farmer raised 3125 bu. of wheat on 100 acres of land. How many bushels was this per acre?

13. The tax rate in a certain town is $4.50 per $100. What is the tax rate per $1?

14. The Mother's Club paid $64 for 100 lb. of candy. How much is this per pound?

15. A 1-dollar can of weed killer is enough for 1000 square feet of lawn. What is the cost per square foot for weed killer?

## Business Problems




Business and government agencies make studies of wages, prices, and living costs. Financial experts solve the sort of problems given below.

1. Mr. Duke worked 4 hours to earn enough pay for a hat costing $10. How much did Mr. Duke earn per hour?

2. Mr. Dale worked $\frac{1}{2}$ hour to earn enough to pay for a tie costing $1.50. How much did Mr. Dale earn per hour?

3. A mechanic worked .4 hour to earn enough to pay for a pound of steak which cost $1.10 per pound. How much did the mechanic earn per hour?

4. Mr. Horn worked .75 hr. to earn enough to pay for a haircut. The haircut cost $1.20. How much did Mr. Horn earn per hour?

5. Mr. Jones worked 1.25 hr. to earn enough to pay for a bushel of apples. The apples were $3 a bushel. How much did Mr. Jones earn per hour?

6. Who can buy more steak, today's worker, who earns $1.50 per hour and pays $1.00 per pound for steak, or the worker of 40 years ago, who earned 20¢ per hour and bought steak for 20¢ a pound?

7. The price of a dress is $24.60. A dress of the same quality cost $9.84 forty years ago. The price of the dress is how many times as much today as it was 40 years ago?

8. A woman factory worker can earn enough in 16.4 hr. to pay for a dress that costs $24.60. How much does she earn per hour?

9. A woman factory worker forty years ago had to work 32.8 hr. to earn enough for a dress that cost $9.84. How much did she earn per hour?

10. A man factory worker earns an average of $67.20 a week. He

works an average of 38.4 hr. per week. How much does he earn per hour?

**11.** Forty years ago there were about 40,000,000 workers in the United States. About .32 of them were farm workers. How many farm workers were there 40 years ago?

**12.** Today the United States has about 9,600,000 farm workers. This is about .16 of all the workers. How many workers are there in all?

**13.** Forty years ago the average consumer in one year used farm products that retailed for $140. The farmer had received $56 for the products. What decimal part of the retail price did he get?

THINK: $56 ÷ $140 = ?

**14.** In one year, today's consumer uses farm products that retail for about $750. The farmer receives about $360 for these products. What decimal part of the retail price does the farmer get?

THINK: $360 ÷ $750 = ?

**15.** The yearly farm income in one state is about $2,360,000,000. About .4 of this is from the sale of hogs. What is the income from the sale of hogs?

**16.** In one state the annual income from the sale of tobacco is about $540,000,000. This is about .6 of the total farm income of the state. What is the total farm income of that state?

**17.** The total farm income in one state is about $212 million. About $53 million of this comes from the sale of eggs. What decimal part of the total income is from eggs?

**18.** Building material that costs $1 today would have cost 40¢ twenty years ago. The material for a certain home cost $3720 twenty years ago. What would the same material cost today?

**19.** Food that cost $1 twenty years ago would cost $2.50 today. A family spends $100 a month for food. How much would the same food have cost twenty years ago?

**20.** The average wage in one factory is $1.75 an hour. The average worker works 38.4 hr. per week. How much does the average worker earn per week?

**21.** Mr. Hale worked 37.5 hr. and earned $69. What did he earn per hour?

**22.** A company paid wages amounting to $360,000 in one year. This was .72 of the company's total income. What was the total income for the year?

## How Well Have You Learned?

*Write as decimals.*

1. $\frac{7}{10}$ $\frac{37}{100}$ $\frac{9}{100}$ $\frac{29}{1000}$
2. Nine tenths.
3. Thirteen hundredths.
4. Twelve and six thousandths.

*Follow the signs.*

5.

| | | |
|---|---|---|
| .46 | 1.3 | 16.01 |
| .05 | 6.0 | 2.73 |
| .14 | .9 | .06 |
| .07 | .6 | 4.75 |
| +.75 | +7.9 | +.34 |

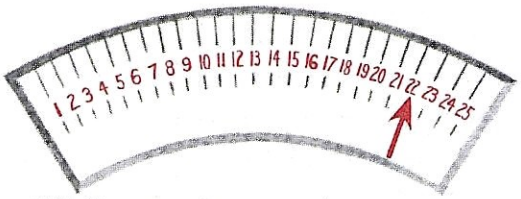
6.

| | | |
|---|---|---|
| 567.0 | 4.72 | 7.304 |
| −280.4 | −2.97 | −4.058 |

*Copy the answers below and place decimal points correctly.*

7. 9.6×.125=1200
8. 2.8×7.3=2044
9. 320×.025=8000
10. 7.44÷.6=1240
11. 4.2÷.08=5250
12. .84÷1.2=7000

13. Round to the nearest tenth.
    4.824 6.3795 38.4367
14. Round to the nearest hundredth.
    6.889 8.3728 54.8257
15. Change the following decimals to fractions in simplest form.
    .375 .05 .125 .875




*Write answers only.*

16. 100×.04 6÷100
17. 10×.025 .75÷10
18. 1000×1.25 375÷1000

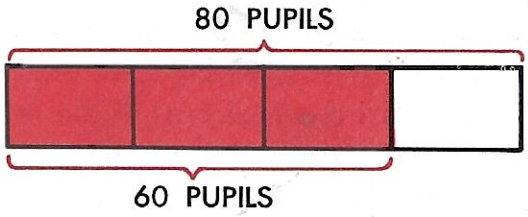
*Write the numbers midway between —*

19. .24 and .26 .20 and .30
20. .64 and .65 .6 and .7

*Write with $ and decimal point.*

21. 5 cents 8 mills
22. $\frac{3}{4}$ dollar $1\frac{4}{5}$ dollar

23. There were 80 students in a class. Sixty students voted in a class election. What per cent of the class did not vote in the election?




24. Twenty-four girls were in a class. This was .6 of the whole class. What was the number in the whole class?

25. John saves .4 of his earnings. He saved $12 last month. How much did he earn last month?

## Help Yourself to Improve

*Tell which is larger.* (75)

1. .9 or 1 2.01 or 1.99
2. .75 or .8 .75 or .08

*Copy and add.* (76)

3. .138; 1.200; 7.156; .059
4. \$2; 35¢; \$1.12; \$.72; 5¢

*Copy and follow the signs.* (77)

5. 10.0 − 7.2 .532 − .145
6. 1.31 − .85 \$5 − 72¢

*Copy and multiply.* (80)

7. .6 × 3.27 .24 × 4.62
8. .04 × 2.5 2.8 × 5.25

*Copy and divide.* (83)

9. 5.12 ÷ .8 34.3 ÷ .07
10. 9 ÷ .225 .84 ÷ 1.2

*Write the products.* (82)

11. 10 × .016 100 × 6.4

*Write the quotients.* (91)

12. 4.7 ÷ 10 .64 ÷ 10

*Round to —* (82)

13. Hundredths: 6.138; .4362
14. Tenths: 7.72; .366

*Write as decimals.* (88)

15. $\frac{7}{10}$ $\frac{3}{4}$ $\frac{4}{5}$ $\frac{3}{8}$

*Write as fractions.* (89)

16. .4 .25 .875 .17

17. Ellen read that potatoes are about .9 water. How many pounds of water are in 60 lb. of potatoes? (80)

18. Tom made 3 hits out of 8 times at bat. Find his batting average correct to thousandths. (88)

19. Six tenths of Carl's rabbits are white. He has 15 white rabbits. How many rabbits does he have in all? (86)

20. Mr. Jones paid \$275 for 100 bushels of apples. How much was this per bushel? (91)

21. Jack averaged 17.5 miles per gallon of gasoline. How many miles can he expect to drive with 6 gallons of gasoline? (80)

22. The freight rate on furniture is \$4.80 per 100 lb. At this rate what would be the freight on a table that weighs 250 lb.? (80)

23. Mr. Hale paid \$9 for 375 used bricks. How much was this per brick? Per 1000 bricks? (82, 83)

24. A highway 3.6 mi. long cost \$1,350,000. What was the cost per mile? (83)

25. Ray worked $7\frac{1}{2}$ hours and earned \$8.40. How much per hour did he earn? (83, 88)

## Show That You Know

*Write as common fractions in lowest terms.*

1. .75 $.33\frac{1}{3}$ .375 .9
2. .80 $.37\frac{1}{2}$ $.06\frac{1}{4}$ .6

*Write as decimals.*

3. $\frac{1}{4}$ $\frac{3}{8}$ $\frac{9}{100}$ $\frac{5}{8}$

*Which is larger —*

4. 3.7 or .49? $\frac{1}{4}$ or .3?

*Copy and add.*

5. 6.30; .54; 8.06; .09
6. 30¢; \$.75; \$3; \$1.10

*Copy and follow the signs.*

7. $4.002 - .075$ $8.00 - 2.75$
8. $18 \times 7.5$ $3.02 \times .45$
9. $12.41 \div .17$ $554.4 \div .84$

*Copy the answers below placing decimal points correctly.*

10. $.17 \times 4.49 = 7633$
11. $.019 \times 39.7 = 7543$
12. $114.33 \div 3.7 = 0309$
13. $11.771 \div 14.9 = 0790$
14. $1083.3 \div 69 = 1570$
15. $1.0541 \div .83 = 1270$

*Write answers only.*

16. $.07 \times 10$ $.03 \div 10$
17. $3.2 \times 100$ $3.2 \div 100$
18. $.015 \times 1000$ $1.5 \div 1000$

*Write the missing numbers.*

19. One tenth = ? hundredths.
20. One one = ? tenths.
21. One ten = ? tenths.
22. Four fifths = ? tenths.

23. Say or write a rule for multiplying a number by 10; by 100; by 1000.

24. Say or write a rule for dividing a number by 10; by 100; by 1000.

25. Say or write a rule for placing the decimal point correctly in a sum. In a difference. In a product. In a quotient.

26. A train left at 10:30 A.M. and arrived at 2:15 P.M. The distance was 180 miles. What was the average speed of the train in miles per hour?

27. Give a rule for rounding a decimal to the nearest thousandth. To the nearest hundredth. To the nearest tenth. To the nearest whole number.

28. A rug 9 ft. by 12 ft. cost \$135. How much is this per square foot? Per square yard?

29. Aluminum sheets are .025 in. thick. How many sheets are needed to make a pile 1 in. thick?

## Understanding Per Cents

1. Which of the coats in the window contains more wool? We may compare these fractions by finding a common denominator. Explain.

▶ It is easier to compare whole numbers than it is to compare fractions. We use whole numbers to compare fractions if we change each fraction to a *per cent*. Think of the goods in each coat as being made up of 100 parts. Each part is 1 hundredth of the whole, or 1 *per cent*. How many hundredths of the first coat are wool? Of the second coat?

THINK: $\frac{4}{5} \times 100$ hundredths = ? hundredths. $\frac{7}{8} \times 100$ hundredths = ? hundredths.

Since *per cent* means *hundredths*, $\frac{4}{5}$, or 80 hundredths, is equal to 80 per cent (80%). $\frac{7}{8}$, or $87\frac{1}{2}$ hundredths, is equal to $87\frac{1}{2}$ per cent ($87\frac{1}{2}\%$).

2. In the sweater in the picture, how many parts out of 100 are wool? What fraction is this? What decimal? How many parts are dacron? What fraction is this? What decimal? Notice the different ways in which we can think of these parts.

Wool — $\frac{75}{100} = .75 = 75\%$

Dacron — $\frac{25}{100} = .25 = 25\%$

3. How many parts out of 100 in the suit in the picture are wool?

THINK: $100\% = \frac{100}{100} = 1.00$ = all of it. Then, all of something, or a whole thing, is ? % of the thing.

4. If Lois spelled 85 out of 100 words correctly in a spelling test, what decimal part did she have correct? What per cent?

THINK: $\frac{85}{100} = .?? = ?\%$

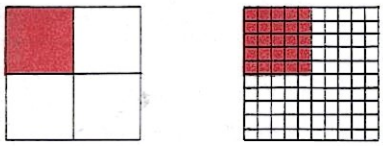
5. If Lucy had 3 out of 4 arithmetic problems correct, what fraction of them were correct? What decimal? What per cent?

THINK: $\frac{3}{4} = \frac{?}{100} = .?? = ?\%$

■ **Per cent means hundredths. A fraction with denominator 100 can be changed easily to a per cent.**

## Fractions and Per Cents

1. How do these squares show that $\frac{1}{4}$ is equal to $\frac{25}{100}$ or 25%? What fraction of the large square at right is each small square? Each small square is what per cent?



2. Draw squares and color them to show these per cents:

50% 75% 10% 20% 98%

3. Jim's basketball team won 3 out of 5 games. What fraction did they win? Don's team won 64% of its games. Which team won the larger per cent of its games?

THINK: $\frac{3}{5} = .60 = \square\%$

4. Bob's team had won only $\frac{1}{8}$ of its games. What decimal is this? What per cent?

*Study these examples.*

$\frac{3}{5} = .60 = .60.\% = 60\%$

The decimal point at the end of a number may be omitted.

$\frac{1}{8} = .12\frac{1}{2} = .12\frac{1}{2}\% = 12\frac{1}{2}\%$

A fraction does not occupy a place in our number system.

5. What happens to a decimal when you move the decimal point one place to the right? By what number are you multiplying when you move the decimal point two places to the right?

6. Multiply .75 by 100 by moving the decimal point two places to the right. Now we have $\square$ wholes. When we give these wholes the name *per cent,* we see that .75 equals 75%. Explain.

■ **To change a decimal to a per cent, move the decimal point two places to the right and add a per cent sign.**

7. Change .375 to a per cent.

THINK: .375 = .37.5% = $\square$ %

*Change to per cents.*

8. .75 .35 .08 .40 .05

9. .01 $.06\frac{1}{4}$ $.37\frac{1}{2}$ .18 $.33\frac{1}{3}$

10. .125 .98 .875 $.66\frac{2}{3}$ .03

11. Explain how these per cents were changed to decimals.

$25\% = .25.\% = .25$

$87.5\% = .87.5\% = .875$

$4\% = .04.\% = .04$

$12\frac{1}{2}\% = .12\frac{1}{2}.\% = .12\frac{1}{2}$

12. Make up a rule for changing a per cent to a decimal.

*Change to decimals.*

13. 20% 32% 3% $4\frac{1}{2}\%$ 10%

14. 16% 18.5% 5% $6\frac{1}{4}\%$ 87.5%

## EQUIVALENT FRACTIONS, DECIMALS, AND PER CENTS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $\frac{1}{2}$ | = .50 = | 50% | $\frac{1}{8}$ | = $.12\frac{1}{2}$ or .125 = | $12\frac{1}{2}\%$ | or | 12.5% |
| $\frac{1}{4}$ | = .25 = | 25% | $\frac{3}{8}$ | = $.37\frac{1}{2}$ or .375 = | $37\frac{1}{2}\%$ | or | 37.5% |
| $\frac{3}{4}$ | = .75 = | 75% | $\frac{5}{8}$ | = $.62\frac{1}{2}$ or .625 = | $62\frac{1}{2}\%$ | or | 62.5% |
| $\frac{1}{5}$ | = .20 = | 20% | $\frac{7}{8}$ | = $.87\frac{1}{2}$ or .875 = | $87\frac{1}{2}\%$ | or | 87.5% |
| $\frac{2}{5}$ | = .40 = | 40% | $\frac{1}{3}$ | = $.33\frac{1}{3}$ or .333 = | $33\frac{1}{3}\%$ | or | 33.3% |
| $\frac{3}{5}$ | = .60 = | 60% | $\frac{2}{3}$ | = $.66\frac{2}{3}$ or .667 = | $66\frac{2}{3}\%$ | or | 66.7% |
| $\frac{4}{5}$ | = .80 = | 80% | $\frac{1}{6}$ | = $.16\frac{2}{3}$ or .167 = | $16\frac{2}{3}\%$ | or | 16.7% |
| $\frac{1}{10}$ | = .10 = | 10% | $\frac{5}{6}$ | = $.83\frac{1}{3}$ or .833 = | $83\frac{1}{3}\%$ | or | 83.3% |

**15.** Explain how these fractions were changed to per cents.

$\frac{1}{4} = .25 = 25\%$ $\frac{1}{14} = 14\overline{)1.00}\ .07\frac{2}{14} = 7\frac{1}{7}\%$

$\frac{1}{3} = .33\frac{1}{3} = 33\frac{1}{3}\%$ $\quad 98$

$\frac{1}{8} = .125 = 12.5\%$ $\quad 2$

**16.** Make up a rule for changing a common fraction to a per cent.

*Change to per cents.*

**17.** $\frac{1}{2}$ $\frac{3}{4}$ $\frac{3}{5}$ $\frac{7}{10}$ $\frac{1}{5}$

**18.** $\frac{1}{3}$ $\frac{1}{8}$ $\frac{1}{6}$ $\frac{5}{8}$ $\frac{2}{3}$

**19.** Explain how these per cents were changed to common fractions.

$25\% = \frac{25}{100} = \frac{1}{4}$

$33\frac{1}{3}\% = \frac{33\frac{1}{3} \times 3}{100 \times 3} = \frac{100}{300} = \frac{1}{3}$

**20.** Make up a rule for changing a per cent to a common fraction.

*Change to fractions in lowest terms.*

**21.** 35% 20% 4% 40% 80%

**22.** 75% 50% 5% $66\frac{2}{3}\%$ $12\frac{1}{2}\%$

**23.** Study the table of equivalents given at the top of the page. These are some of the most commonly used fractions, decimals, and per cents. Learning these equivalents from memory will save you time as you work problems using per cents.

*Change to decimals and per cents.*

**24.** $\frac{3}{8}$ $\frac{1}{6}$ $\frac{2}{5}$ $\frac{1}{10}$ $\frac{1}{3}$ $\frac{1}{50}$

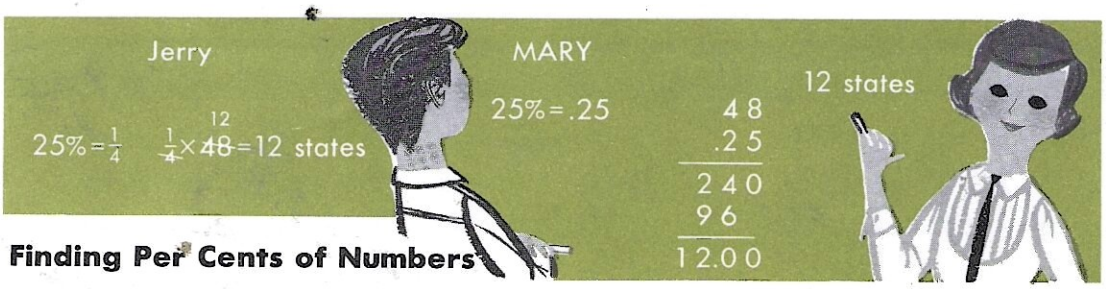
**25.** $\frac{5}{8}$ $\frac{5}{6}$ $\frac{4}{5}$ $\frac{7}{10}$ $\frac{2}{3}$ $\frac{1}{40}$

**26.** $\frac{7}{8}$ $\frac{1}{2}$ $\frac{9}{10}$ $\frac{1}{20}$ $\frac{3}{4}$ $\frac{1}{16}$

*Change to decimals and fractions in lowest terms.*

**27.** 20% $33\frac{1}{3}\%$ $6\frac{1}{4}\%$ 25% 45%

**28.** 2% $12\frac{1}{2}\%$ 8% 50% 87%




## Finding Per Cents of Numbers

1. The class read in their geography books that 25% of the states in the United States raise cotton. The picture shows how two students found the number of states. Were both methods correct? Why? Which method was faster? Why?

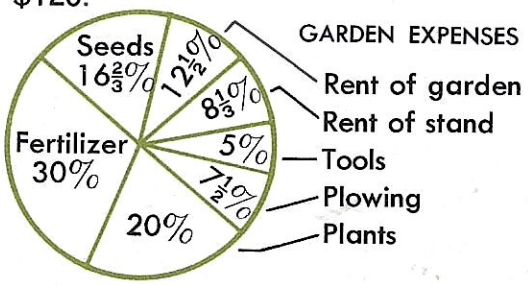
2. Joe read that $33\frac{1}{3}\%$ of the people of South Dakota live in rural areas. An atlas gave the population as 652,740. Use two different ways to find how many people live in the rural areas. Which way is quicker? Why?

3. Last year Mr. Davis stored 540 bushels of apples. He later found that $16\frac{2}{3}\%$ of them spoiled. How many bushels spoiled? Which method did you use? Why?

4. Mr. Davis stored 325 bushels of potatoes. 16% of them spoiled. How many bushels spoiled? Is there an easy fraction equivalent for 16%? Which method is easier?

**To find a per cent of a number, write the per cent as a fraction or as a decimal. Multiply by the fraction or decimal.**

Jack planned to raise a large garden to earn money. He had \$120 to pay expenses. This circle graph tells how he would use the \$120.




5. Find the total of the per cents allowed for the different items of expense. Should the sum be 100%? Why?

6. How many dollars did Jack allow for each item of expense?

7. Jack bought 480 cabbage plants. $37\frac{1}{2}\%$ of them died. How many died? How many were left?

8. Jack bought 450 tomato plants. 12% of them died. How many of the tomato plants died?

9. Jack raised 150 melons. 28% of them were unfit for use. How many were unfit for use? How many were good?

*Find these percentages. With each example decide which method will be easier and use that method.*

10. 20% of 155 75% of 160 50% of 156 15% of 200 25% of 320

11. $12\frac{1}{2}\%$ of 648 35% of 180 87.5% of 176 $8\frac{1}{3}\%$ of 48 $37\frac{1}{2}\%$ of 40

12. $6\frac{1}{4}\%$ of 80 $16\frac{2}{3}\%$ of 90 $6\frac{2}{3}\%$ of 75 47% of 500 $66\frac{2}{3}\%$ of 75

**Working on Commission**

Jack hired Mary to help him sell vegetables from his roadside stand. He agreed to pay her a part of the money she took in. This part, usually stated as a per cent, is called the *rate of commission*. Mary's earnings are her *commission*.

1. Mary sold a bag of potatoes for \$4.50. Her rate of commission was 6%. How much was her commission on this sale?

THINK: .06 × \$4.50 = ☐

2. In one day, Mary sold 24 bags of potatoes at \$4.50 a bag. Her rate of commission was 6%. Find her commission.

3. Mary sold tomatoes for \$5.50. Her rate of commission was 8%. What was the amount of her commission?

4. Corn was easy to sell. The rate of commission was only 1%. Mary sold 14 dozen ears at 50¢ a dozen. Find her commission.

5. Watermelons were hard to sell. The rate of commission was $12\frac{1}{2}\%$. Mary sold a large one for \$1.50 and two small ones for 85¢ apiece. Find her commission.

6. She sold 40 bunches of carrots at 2 bunches for 15¢. Her rate of commission was 2%. Find the commission.

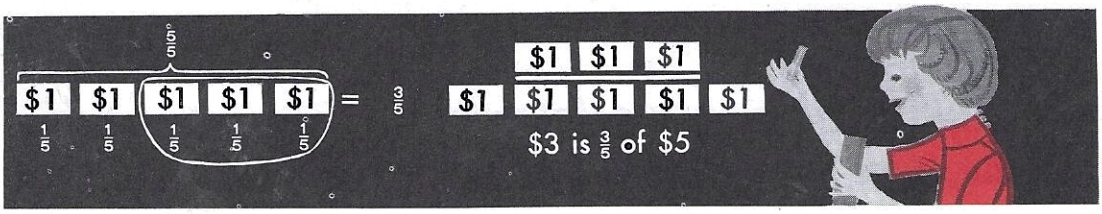
7. Mary sold 12 boxes of berries at 3 boxes for 85¢. The rate of commission was 4%. What was the amount of her commission?

8. Mary's father sells real estate. His commission on certain houses is 5%. If he sold one of these for \$12,500, how much was his commission?

9. Mary's father sold a farm for \$52,500. What was his commission if the rate of commission was $2\frac{1}{2}\%$?

10. Find the commission on \$16,500 at each of the rates given:

4% $3\frac{1}{4}\%$ $2\frac{1}{2}\%$ 5% 2%




## Finding Per Cents

1. Mary spent \$3 of the \$5 she had received for her birthday. What part of her money did she spend? Explain Mary's figuring.

Notice that to compare the number of dollars spent (\$3) with the number of dollars she had in all (\$5), Mary made a fraction with these numbers as numerator and denominator. This fraction shows what part the one number is of the other number.

2. What per cent is \$3 of \$5?
THINK: \$3 out of \$5 = $\frac{3}{5}$ = ?%

3. What fraction of her money would Mary have spent if she had spent only \$2 out of her \$5? What per cent?

4. How many small squares are there in large square A at the bottom of this page? How many small squares are red? What fraction of the small squares are red? What per cent?

5. What fraction of B is red? What per cent?

6. How many small squares are there in C? What per cent of C is red?

7. What per cent of D is red?

8. What fraction of E is red? Complete and explain the following ways of changing this fraction to a per cent? Which way do you like better? Why?

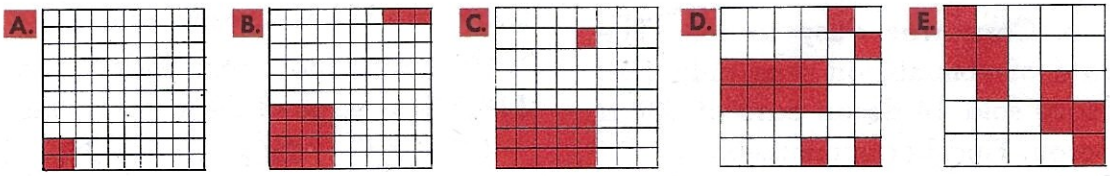
$$\frac{8}{25} = \frac{8 \times 4}{25 \times 4} = \frac{?}{100} = .?? = ?\%$$

$$\frac{8}{25} = 25\overline{)8.00} \qquad .?? = ?\%$$

9. During basketball practice Don made 14 baskets out of 20 shots. What per cent of his shots did he make?

10. Bob made 16 out of 25 shots. What per cent did he make?

11. 14 out of 20 is at the same rate as ? out of 100.



12. 16 out of 100 is ☐%.

13. 42 out of 100 is ☐%.

14. 24 out of 50 is ☐%.

15. 13 out of 25 is ☐%.

16. Of the 30 students in Betty's class, 18 were girls. What per cent were girls? Is $\frac{18}{30}$ a commonly used fraction for which you have learned a decimal equivalent? How can you change this fraction to a per cent?

17. Joel read that there are 104 pounds of oxygen in the body of a man weighing 160 pounds. What per cent of the human body is oxygen?

THINK: 104 out of 160 = $\frac{104}{160}$ = ☐

■ **To find what per cent one number is of another number, make a fraction by placing the first number over the other, and change the fraction to a per cent.**

*Find what per cent the red number is of each number in the same row.*

| | a | b | c | d | |
|---|---|---|---|---|---|
| 18. | 60 | 48 | 144 | 240 | 12 |
| 19. | 40 | 48 | 80 | 240 | 8 |
| 20. | 25 | 50 | 100 | 120 | 5 |
| 21. | 30 | 75 | 150 | 450 | 15 |
| 22. | 50 | 75 | 400 | 500 | 25 |
| 23. | 32 | 48 | 96 | 256 | 16 |

▶ This chart shows how the Abrams family uses its monthly income.

| ITEM | AMOUNT | ITEM | AMOUNT |
|---|---|---|---|
| Food | $108 | Clothes | $45 |
| Rent | 90 | Household Needs | 30 |
| Savings | 36 | Miscellaneous | 51 |

24. What is the Abrams family's total monthly income?

25. What per cent of the monthly income is used for food?

THINK: $\frac{108}{360}$ = ☐%

26. What per cent of the monthly income is used for each of the other items?

▶ A used car dealer paid $300 for a car. Repairs cost $125. He sold the car for $625.

27. What was the dealer's profit? What per cent was this of the selling price?

28. The cost of the car was what per cent of the selling price?

*Work as you did* 18-23.

| | a | b | c | d | |
|---|---|---|---|---|---|
| 29. | 90 | 27 | 144 | 270 | 18 |
| 30. | 36 | 42 | 240 | 480 | 24 |
| 31. | 48 | 80 | 128 | 320 | 32 |
| 32. | 48 | 54 | 144 | 180 | 36 |
| 33. | 50 | 60 | 80 | 100 | 40 |
| 34. | 72 | 80 | 96 | 144 | 48 |

## More about Commission

1. Mr. Scott wanted to find the rate of commission offered in the advertisement at the right. He figured that the price of a new car was about $2500. At this price, how much would 20 cars bring in? What per cent would the commission be of the total sales?

AUTO SALESMAN WANTED
EXPERIENCED ONLY
If you are capable of delivering 20 cars or better per month, this job will pay upwards of $1500 per month. Apply in person. See sales manager.
ABC AUTO SALES
1800 S. Main St.

2. Where Mr. Scott now works he receives $250 per month plus a commission of 2% on all sales over $5000. Last month his sales were $26,000. What was his commission? What were his total earnings?

3. Mr. Robbins received $900 for selling $22,500 worth of cars. What was the rate of his commission?

4. The Parker Real Estate Company paid a salesman $348 for selling a home for $11,600. What rate of commission did the salesman receive?

5. Another salesman received $247.50 for selling a home costing $12,375. What rate of commission did he receive?

6. Because a house was difficult to sell, Mrs. Luden received a commission of 6%. She sold the house for $14,000. What was her commission?

7. What are the advantages of paying a salesman a commission rather than a salary? Why do some employers pay both?

8. Robert sells magazines at 15¢ each. What is the rate of his commission if he receives $1.50 for selling 25 magazines?

9. Jerry helps in his father's drug store on week ends. One week his sales amounted to $293.20 and he was paid $14.66. What was the rate of Jerry's commission?

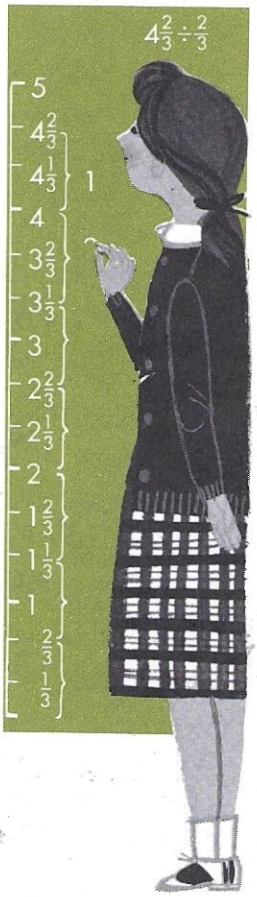
10. The amount of money left after commission has been paid is called the *net proceeds*. What were the net proceeds for Mr. Black's company if he sold $8000 worth of goods and received a commission of $680? What was the rate of commission? What per cent were the net proceeds of the selling price?

11. What was the commission on a sale of $2400 if the rate was $7\frac{1}{2}$%? The net proceeds?

## No Pencils, Please

Fractions are very important in arithmetic. This page will help you review the addition, subtraction, multiplication, and division of fractions.

*Follow the signs. Write each answer in lowest terms.*




| | | | | | |
|---|---|---|---|---|---|
| 1. | $\frac{1}{3}+\frac{1}{3}$ | $\frac{1}{4}+\frac{1}{4}$ | $\frac{1}{8}+\frac{3}{8}$ | $\frac{5}{6}-\frac{1}{6}$ | $\frac{7}{8}-\frac{1}{8}$ |
| 2. | $\frac{2}{5}+\frac{1}{5}$ | $\frac{1}{6}+\frac{2}{6}$ | $\frac{3}{8}-\frac{2}{8}$ | $\frac{3}{4}-\frac{1}{4}$ | $\frac{4}{5}-\frac{3}{5}$ |
| 3. | $\frac{1}{2}+\frac{1}{4}$ | $\frac{1}{6}+\frac{1}{2}$ | $\frac{1}{2}-\frac{1}{6}$ | $\frac{1}{2}-\frac{1}{3}$ | $\frac{5}{8}-\frac{1}{4}$ |
| 4. | $\frac{1}{3}+\frac{1}{6}$ | $\frac{5}{8}+\frac{1}{4}$ | $\frac{3}{4}-\frac{1}{2}$ | $\frac{7}{8}-\frac{1}{2}$ | $\frac{1}{2}-\frac{1}{6}$ |
| 5. | $\frac{3}{8}+\frac{1}{2}$ | $\frac{1}{6}+\frac{2}{3}$ | $\frac{1}{8}+\frac{1}{4}$ | $\frac{5}{6}-\frac{1}{3}$ | $\frac{1}{3}-\frac{1}{6}$ |
| 6. | $6\times\frac{1}{3}$ | $6\times\frac{2}{3}$ | $\frac{5}{6}\times 3$ | $3\div\frac{1}{2}$ | $5\div\frac{1}{3}$ |
| 7. | $8\times\frac{1}{4}$ | $\frac{3}{4}\times 8$ | $6\div\frac{1}{6}$ | $2\div\frac{1}{4}$ | $2\div\frac{1}{5}$ |
| 8. | $\frac{2}{3}\times\frac{2}{5}$ | $\frac{2}{3}\times\frac{3}{5}$ | $2\div\frac{1}{3}$ | $2\div\frac{2}{3}$ | $3\div\frac{3}{4}$ |
| 9. | $\frac{1}{2}\times\frac{3}{4}$ | $\frac{3}{4}\times\frac{2}{5}$ | $\frac{5}{8}\times\frac{4}{5}$ | $3\div\frac{1}{4}$ | $5\div\frac{1}{5}$ |
| 10. | $2\frac{1}{2}\times 2$ | $1\frac{2}{3}\times 3$ | $1\frac{1}{2}\times 4$ | $1\frac{2}{3}\div\frac{1}{3}$ | $1\frac{1}{2}\div\frac{1}{2}$ |
| 11. | $1\frac{3}{4}\times 8$ | $1\frac{3}{8}\times 2$ | $\frac{3}{4}\div\frac{1}{4}$ | $\frac{1}{2}\div\frac{1}{4}$ | $\frac{1}{2}\div\frac{5}{6}$ |
| 12. | $\frac{1}{2}\times 1\frac{1}{3}$ | $\frac{1}{4}\times 1\frac{3}{5}$ | $\frac{1}{2}\div\frac{1}{3}$ | $\frac{1}{2}\div\frac{1}{6}$ | $\frac{4}{5}\div\frac{1}{2}$ |
| 13. | $\frac{1}{3}\times 1\frac{1}{2}$ | $\frac{1}{5}\times 1\frac{2}{3}$ | $\frac{1}{8}\times 1\frac{1}{3}$ | $\frac{1}{3}\div\frac{1}{6}$ | $\frac{3}{4}\div\frac{1}{3}$ |
| 14. | $3\times 3\frac{1}{3}$ | $4\times 2\frac{1}{4}$ | $2\times 1\frac{1}{4}$ | $2\frac{1}{2}\div 2$ | $9\div 4$ |
| 15. | $5\times 1\frac{1}{2}$ | $3\times 2\frac{1}{2}$ | $7\frac{1}{2}\div 3$ | $7\frac{1}{2}\div 5$ | $10\div 3$ |

| | | | | | |
|---|---|---|---|---|---|
| 16. | $2\frac{1}{3}$ $+3\frac{1}{3}$ | $2\frac{1}{4}$ $+1\frac{1}{4}$ | $3\frac{1}{8}$ $+2\frac{1}{8}$ | $1\frac{1}{6}$ $+2\frac{1}{6}$ | $3\frac{1}{2}$ $+1\frac{1}{2}$ |
| 17. | $2\frac{2}{3}$ $-1\frac{1}{3}$ | $3\frac{3}{4}$ $-2\frac{1}{4}$ | $2\frac{7}{8}$ $-1\frac{3}{8}$ | $3\frac{5}{6}$ $-2\frac{1}{6}$ | $3\frac{1}{2}$ $-1\frac{1}{2}$ |
| 18. | $3\frac{1}{3}$ $+\frac{2}{3}$ | $3\frac{1}{4}$ $+\frac{3}{4}$ | $1\frac{7}{8}$ $+\frac{1}{8}$ | $2\frac{1}{6}$ $+\frac{5}{6}$ | $4\frac{2}{5}$ $+\frac{3}{5}$ |
| 19. | $2\frac{1}{4}$ $-\frac{2}{4}$ | $2\frac{1}{3}$ $-\frac{2}{3}$ | $2\frac{1}{8}$ $-\frac{3}{8}$ | $3\frac{1}{6}$ $-\frac{5}{6}$ | $3\frac{2}{5}$ $-\frac{4}{5}$ |
| 20. | $3\frac{1}{4}$ $+\frac{1}{2}$ | $2\frac{1}{3}$ $+\frac{1}{6}$ | $3\frac{1}{2}$ $+\frac{1}{8}$ | $4\frac{1}{6}$ $+\frac{1}{2}$ | $2\frac{1}{5}$ $+\frac{3}{10}$ |
| 21. | $2\frac{1}{2}$ $-\frac{1}{4}$ | $3\frac{1}{2}$ $-\frac{1}{6}$ | $1\frac{1}{2}$ $-\frac{1}{3}$ | $4\frac{1}{2}$ $-\frac{1}{2}$ | $2\frac{1}{2}$ $-\frac{1}{8}$ |

### Selling at a Discount

1. When Jack sees that he will probably have vegetables left in his stand at the end of the day, he sells them at a reduced price rather than keep them and have them spoil. We say that he sells them at a discount. The *discount* is the amount by which a regular price is reduced.

Find the discount on each item in Jack's stand. Find the reduced price for each item.

▶ Discounts are very common in business. A merchant may reduce prices at the end of the season to make way for new goods.

2. Prove that each reduced price shown in this advertisement is correct.

| | | | |
|---|---|---|---|
| *Winter* | *$45* | Suits..... | now $33.75 |
| *Wear* | *$10* | Hats..... | now $ 7.50 |
| *Reduced* | *$59* | Suits..... | now $44.25 |
| 25% | *$4.75* | Gloves.... | now $ 3.56 |

▶ Each of the following items is reduced 25%. How much is the reduced price?

3. A 69-dollar overcoat.

4. Shoes priced at $12.80.

5. A hat regularly priced at $10.

6. Gloves, regular price $3.60.

▶ The marked price is the regular price. The regular price less the discount is called the *net price*.

7. At an after-Christmas sale, all toys were sold for 35% less than the regular price. Mrs. May bought a bear with a regular price of $15. What was the net price?

THINK:

Discount = .35 × $15 = $?

Net Price = $15 − $5.25 = $?

8. How can stores afford to give discounts as large as 35%?

9. Billy bought a sled. The regular price had been $8. What was the net price at the sale?

10. Joan bought a doll that was marked $6.40. How much did she pay at the after-Christmas sale?

*Find discount and net price. Regular price and rate of discount are given.*

| | | |
|---|---|---|
| 11. | $17.50; 2% | $168; $12\frac{1}{2}$% |
| 12. | $.75; 6% | $6.50; 8% |
| 13. | $150; 25% | $19.75; 20% |
| 14. | $6.25; 8% | $8.75; 16% |

## Discounts in Business

1. A men's wear store has a sale of straw hats every August. Why do you think the store has this sale? This year the rate of discount was 50%. What was the sale price of a hat regularly priced at $1.98?

2. A boy's suit was priced at $37.50. The sale price was 20% less. What was the sale price?

3. Mr. Blackshaw has a fruit store. Last week he sold 75-cent baskets of very ripe plums for 45¢ a basket. What was the rate of discount?

THINK: Discount = 75¢ − 45¢ = 30¢
Rate = $\frac{30¢}{75¢}$ = 30¢ ÷ 75¢ = ?

4. The Cut-Rate Drug Store has a monthly sale. Standard items are sold at discounts. The $3.50 bottle of olive oil is marked "30% Off." What is the sale price?

5. The regular price of a chocolate bar is 5¢. The sale price of the same chocolate bars is 3 for 10¢. What is the rate of the discount?

6. The regular price of canned soup is 15¢ a can. The sale price of the same soup is 2 cans for 25¢. What is the rate of discount?

7. An electric bill was $3.40, with 5% discount if paid within 10 days. What is the discount? Why is the electric company willing to give such a discount?

8. The gas company also gives a 5% discount on any bill paid within 10 days. One family's gas bill averages $4.80 a month. How much can they save in a year by paying each bill within 10 days?

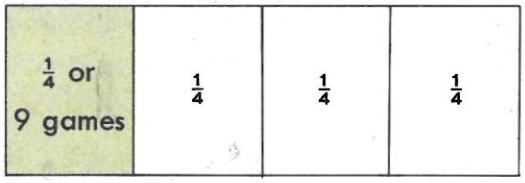
9. A store gives a discount stamp for each 10-cent purchase. Five of these stamps are worth 1¢. Prove that this is equal to a discount of 2%.

A family bought $1500 worth of goods at this store. What is the total value of the discount stamps they got?

10. A bookstore sells books at prices listed in its catalog. The store buys books at a discount of 40% from these prices. What does the store pay for a book listed at $2.50? What is the store's profit?

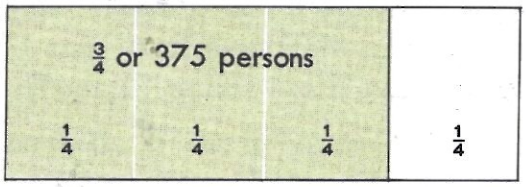
**Finding a Whole from a Part**

1. Carl read that a basketball team had won 9 games, or $\frac{1}{4}$ of all its games. How many games had the team played in all?




THINK: $\frac{1}{4}$ of the games = 9 games
$\frac{4}{4}$, or all, $= 4 \times 9 =$ ?

2. When the Girl Scouts gave a play, 375 persons attended. This was $\frac{3}{4}$ of those who had bought tickets. How many had tickets?



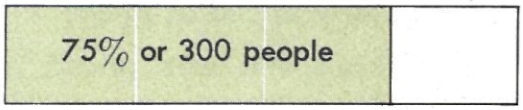

THINK: $\frac{3}{4}$ of tickets $= 375$
$\frac{1}{4}$ of tickets $= 375 \div 3 = 125$
$\frac{4}{4}$ of tickets $= 4 \times 125 =$ ?

3. Carl's troop won six softball games. This was $\frac{2}{3}$ of all the games played. Make a drawing to find how many games were played.

*Make drawings to help solve the following examples.*

4. 12 is $\frac{3}{4}$ of ? 18 is $\frac{3}{4}$ of ?
5. 20 is $\frac{1}{2}$ of ? 21 is $\frac{1}{3}$ of ?
6. 15 is $\frac{3}{5}$ of ? 8 is $\frac{2}{3}$ of ?

7. On a rainy day only 300 people came to a picnic. This was 75% of those who had planned to come. How many had planned to attend?




THINK: 75% = what fraction?

8. If 8 rabbits weigh 40 pounds, what will 100 rabbits weigh?

THINK: 8 rabbits weigh 40 lb.
1 rabbit $= 40 \div 8 = 5$ lb.
100 rabbits $= 100 \times 5 =$ ? lb.

9. One day during the winter 40 pupils were absent from school. This was 8% of the enrollment. What was the total enrollment?

THINK: 8% of total $= 40$
$1\% = 40 \div 8 = 5$
$100\% = 100 \times 5 =$ ?

10. Mary had 54 examples correct on a test and received a mark of 90%. How many examples were in the test?

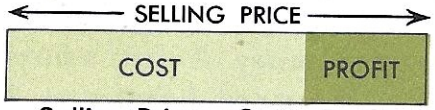
THINK: 90% = 54 examples
1% = 54 ÷ 90 = .6
100% = 100 × .6 = ?

*Solve these examples.*

11. 8 is 10% of ? 24 is 10% of ?
12. 80 is 8% of ? 30 is $16\frac{2}{3}\%$ of ?
13. 75 is $37\frac{1}{2}\%$ of ? 16 is 48% of ?

## Gain and Loss

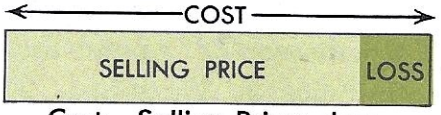
1. When the class went on a hayride, Chuck brought along a box of 24 candy bars which he had bought for 84¢. He sold them to his friends for a nickel apiece, for a total of $1.20. What was his profit? What per cent of the selling price was the profit?




$1.20
−.84
?

Selling Price − Cost = Profit

2. At the next class party Chuck found that three other boys had decided to make money, too. In order to get rid of his candy bars, he sold them for 3¢ each. He had paid 84¢ for the box of 24 bars. What was his loss? What per cent of the selling price was the loss?

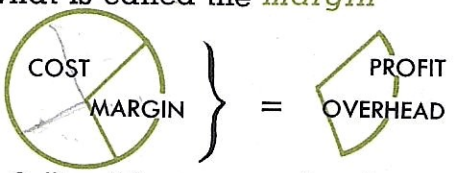



84¢
−72¢
?

Cost − Selling Price = Loss

3. Jim worked evenings at Newton's Drug Store. He noticed that the store paid only 12¢ for a 25¢ tube of toothpaste. He figured that the 13¢ was a profit of $\frac{13}{25}$ or ? %.

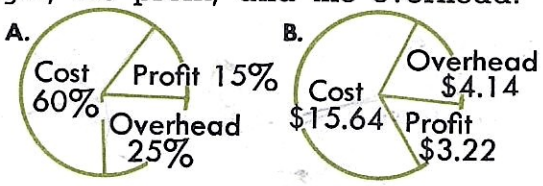
When Jim mentioned this to Mr. Newton, he laughed and explained that the whole 13¢ was not profit. He has many expenses, such as rent, heat, light, wages, and taxes. These are called *operating expenses* or *overhead*. The overhead together with the profit make up what is called the *margin*




Selling Price  Margin

4. Mr. Newton pays $.36 a bottle for hand lotion. He sells it for $.50. What is the margin?

5. Mr. Newton sells face powder at $1 a box. Circle A below shows what per cent of the selling price goes for cost, for profit, and for overhead. Find the cost, the margin, the profit, and the overhead.

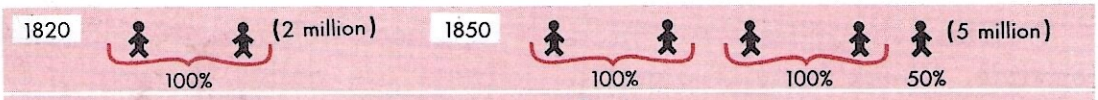



6. Circle B shows the cost, the overhead, and the profit on an electric razor. Find what per cent each of these items is of the selling price.

7. Mr. Drake sold a refrigerator for $240. The cost was 75% of the selling price and his profit was 15%. What was his overhead?

THINK: Overhead = ?% of SP

## Finding More than 100 Per Cent




$$5 \text{ million compared to } 2 \text{ million} = \frac{5 \text{ million}}{2 \text{ million}} = 2\tfrac{1}{2} = 2.50 = 250\%$$

1. "In 1850 there were 250% as many workers in the United States as there were in 1820." When Alice read this statement in her history book, she thought, "You can't have 250% of anything. 100% is the whole and you can't have more." Study the illustration above. Why was Alice wrong?

2. Five million is $2\frac{1}{2}$ times as much as two million. Explain how $2\frac{1}{2}$ or 2.50 was changed to 250% in the example above. Remember the rule for changing a decimal to a per cent.

3. If 100% is equal to a whole thing, then 200% is equal to 2 whole things. Explain. 400% = ? wholes. 700% = ? wholes.

4. Last year there were 20 boys in Tom's Boy Scout troop. This year the troop is $\frac{1}{5}$ larger. How many are in the troop this year? What per cent of the number in the troop last year is the number in the troop this year? Why is it more than 100%?

5. Last year there were 30 girls in Betty's Girl Scout troop. This year the troop is 40% larger. How many are in the troop this year? What per cent is this year's number of last year's number?

6. The Girl Scouts gave a dinner to raise money. A child's ticket was 50¢. An adult ticket was $1\frac{1}{2}$ times as much. What per cent of the child's price was the adult price?

THINK: 100% (child's price)
+50% ($\frac{1}{2}$ of child's price)
?%

7. Betty sold 36 tickets. Ruth sold $116\frac{2}{3}\%$ as many as Betty. How many did Ruth sell?

8. The total from adult tickets was $84.50. The total from children's tickets was 56% more than from adult tickets. What was the total for all the tickets?

THINK:
adult tickets = 100%
children's = 100% + 56% more

*Change to mixed decimals.*

9. 125% $133\frac{1}{3}\%$ 204% $187\frac{1}{2}\%$

10. 450% 235% 314% 110%

*Change to per cents.*

11. 1.25 2 2.50 $1.33\frac{1}{3}$

**Practice with Per Cents**

*Find the answers.*

| | | | | |
|---|---|---|---|---|
| 1. | 3% of \$480 | 65% of \$525 | 25% of \$12.80 | 50% of 1298 |
| 2. | 38% of 895 | 23% of 900 | $83\frac{1}{3}$% of \$18.30 | $6\frac{1}{4}$% of 480 |
| 3. | 91% of 720 | 105% of 640 | $16\frac{2}{3}$% of \$42 | $33\frac{1}{3}$% of 927 |
| 4. | $12\frac{1}{2}$% of 56 | 125% of \$400 | $87\frac{1}{2}$% of \$168 | 100% of 5280 |

| | | | |
|---|---|---|---|
| 5. | 6 is ? % of 8 | 45 is ? % of 150 | 80 is ? % of 40 |
| 6. | 18 is ? % of 72 | 19 is ? % of 380 | 5 is ? % of 2 |
| 7. | 30 is ? % of 45 | 21 is ? % of 56 | 25 is ? % of 75 |
| 8. | 24 is ? % of 60 | 50 is ? % of 900 | 100 is ? % of 500 |

*When solving the following,* THINK: 4% of ? is 16; 1% is $16 \div 4 = 4$; 100% is $100 \times 4 = 400$.

| | | | |
|---|---|---|---|
| 9. | 16 is 4% of ? | 100 is 40% of ? | 30 is 10% of ? |
| 10. | 18 is 9% of ? | 124 is 31% of ? | 25 is $12\frac{1}{2}$% of ? |
| 11. | 160 is 80% of ? | 90 is 60% of ? | 250 is 125% of ? |
| 12. | 80 is 25% of ? | 6 is $33\frac{1}{3}$% of ? | 6 is 200% of ? |

| | | | | |
|---|---|---|---|---|
| 13. | $\frac{1}{50} = .02 =$ ? % | ? = ? $= 16\frac{2}{3}$% | ? $= .10 =$ ? % | ? $= .62\frac{1}{2} =$ ? % |
| 14. | $\frac{1}{40} =$ ? $= 2\frac{1}{2}$% | $\frac{1}{2} =$ ? $=$ ? % | $\frac{1}{8} =$ ? $=$ ? % | $\frac{3}{10} =$ ? $=$ ? % |
| 15. | ? $= .05 =$ ? % | ? $= .75 =$ ? % | $\frac{5}{6} = .83\frac{1}{3} =$ ? % | $\frac{1}{3} =$ ? $=$ ? % |
| 16. | ? $= .08\frac{1}{3} = 8\frac{1}{3}$% | $\frac{2}{3} =$ ? $=$ ? % | $\frac{3}{8} =$ ? $=$ ? % | $\frac{7}{8} =$ ? $=$ ? % |

17. Use the table at the right to find how many pounds of each element there would be in a man weighing 150 pounds. In a man weighing 205 pounds. In a child weighing 70 pounds. In a woman weighing 110 pounds.

18. What is the weight of a man whose body contains 4 pounds of calcium?

THINK: 2% of the weight = 4 lb.; 1% = ?; 100% = ?

| ELEMENTS IN THE HUMAN BODY | |
|---|---|
| Oxygen | 65% |
| Carbon | 18% |
| Hydrogen | 10% |
| Nitrogen | 3% |
| Calcium | 2% |
| All others | 2% |

## Problem Solving

To solve the first six problems on this page, you must use some facts that you know but that are not stated in the problems. Tell what fact is missing and solve each problem.

1. In 7 days there are ▯ hours.

2. How many times does the hour hand go around the clock face in 5 days?

3. How many times does the minute hand go around the clock face in 24 hours?

4. Jack pays $30 a week for room and board. How much is this for a year?

5. Jenny pays $25 a month for her room. How much is this for a year?

6. What is the cost of 3 dozen balls at 5¢ for each ball?

To solve each of the next six problems you will need another fact. Choose a sensible fact for each problem from the box below and solve.

| | | |
|---|---|---|
| 2 hours | 5 miles | 8 miles per hour |
| 7 girls | $7.79 | 65¢ per pound |

7. Betty and her friends have an average weight of 96 pounds. What is their total weight?

8. Mr. Hewes walks at the rate of 3 miles per hour. How many miles did he walk yesterday?

9. How far can Albert ride his bicycle in $2\frac{1}{2}$ hours?

10. Find the cost of a 22-pound turkey.

11. When Mr. Allen went to his hunting cabin, he rode 87 miles on a train, 16 miles on a bus, and the rest of the way on horseback. How far is it to the cabin?

12. Mrs. Gray bought a hat. She gave the clerk $20. How much change should Mrs. Gray get back?

Each of the next six problems has a fact that is not needed. Tell what the unnecessary fact is in each problem and solve.

13. Agnes bought four pieces of ribbon at 25¢ a yard. Each piece was 3 yards long. What was the total length of the four pieces?

14. Tom bought four 13-in. balls at 69¢ each. Find the total cost.

15. Charles can drive 16 miles on a gallon of gasoline. The gasoline costs 27¢ a gallon. How far can he drive on 5 gallons?

16. A ham weighed 11 pounds. Mrs. Jones bought $4\frac{1}{2}$ pounds at 56¢ a pound. How much did Mrs. Jones have to pay?

17. A room is 18 feet long and 15 feet wide. A picture molding goes all the way around the room 9 inches below the ceiling. How long is the picture molding?

18. A swimming pool is 66 feet long and 35 feet wide. Earl swam the length of the pool and back to the starting point. How many feet did he swim in all?

▶ Many times, a formula makes it easier to work a problem. The rest of the problems on this page can be solved with formulas.

19. Mr. Jay drove 6 hr. at an average rate of 37 miles per hour. How far did he drive?

In the formula below, *d* stands for *distance*, *r* for the *rate* of speed (miles per hour), and *t* for *time* (hours).

$d = r \times t$ or $d = rt$

$d = 37 \times 6 = \square$

20. Mr. Jay drove 7 hours at the average rate of 38 miles per hour. How far did he drive?

21. Mr. Snow drove 216 miles in 6 hours. What was his average rate in miles per hour?

THINK: If he drove 216 miles in 6 hours, I must divide 216 by 6 to find out how far he drove in one hour. The formula, then, is

$r = d \div t$ or $r = \frac{d}{t}$

22. Mr. Smith drove 300 miles in 8 hours. What was his average rate in miles per hour?

23. Miss Dann needs to drive 245 miles. At an average rate of 35 miles per hour, how long will it take her to make the trip?

THINK: If she drove 35 miles in one hour, I must divide 245 by 35 to find out how many hours she drove. The formula, then, is

$t = d \div r$ or $t = \frac{d}{r}$

24. How long will it take to drive 135 miles at an average rate of 36 miles per hour?

▶ Tell what formula you need to use in solving each problem below. Solve.

25. An airplane flew 852 miles in 3 hours. Find the rate in miles per hour.

26. How long will it take a plane to fly 741 miles at an average rate of 228 miles per hour?

27. Ted flies his training plane at an average rate of 116 miles per hour. How far can he fly it in $1\frac{3}{4}$ hours?

## Renting Money

1. Sam's boats are rented an average of 6 hours a day, for 100 days a year. If he charges 30¢ per hour, how much rent per year does he get from each boat?

2. Sam wanted to buy more boats to rent, but he did not have enough money. At the bank, Mr. Hord said he would be glad to "rent" money to Sam, just as Sam rented his boats. Sam would have to pay 6¢ per year for each dollar he "rented." How much "rent" would he have to pay on $850 for a year?

3. Is it fair to charge rent for the use of a boat? Is it fair to charge "rent" for the use of money?

■ **When money is borrowed, the amount that is borrowed is called the principal. The pay for using, or "renting," the money is called the interest.**

4. If Sam paid 6¢ interest for every dollar of the principal, at what *rate* of interest did he pay?

THINK: 6¢ is $\frac{6}{100}$ or ? % of 100¢

5. Mr. Fell borrowed $250 from the bank. He agreed to pay 5¢ interest on every dollar each year. What was the rate of interest? How much interest did he pay per year?

THINK:
$$\begin{array}{rl} \$250 & \text{principal} \\ \times .05 & \text{rate} \\ \hline ? & \text{interest} \end{array}$$

6. Explain this formula:

$i = p \times r$ or $i = pr$

■ **To find the interest on borrowed money, multiply the principal by the rate of interest.**

7. Mr. Barker read the advertisement on the sign in the picture above. He needed $5000 to finish paying for his home. How much interest would he have to pay per annum (annually, or per year)?

THINK: What is the principal? The rate of interest?

*Find the annual interest on the following at the rates given.*

| | | |
|---|---|---|
| 8. | $3750; 4% | $6250; 6% |
| 9. | $900; 7% | $600; 8% |
| 10. | $1500; 5% | $2500; 3% |
| 11. | $185; 8% | $235; 7% |

## Finding Interest on Borrowed Money

1. Mr. Steel borrowed $500 at 6% for 4 yr. How many dollars in interest will he have to pay?

$500 principal
×.06 rate
$30.00 interest for 1 yr.
×4 time (years)
$120.00 interest for 4 yr.

2. Explain the formula below.

$i = p \times r \times t$ or $i = prt$

3. What fraction of a year is 6 months? What is $t$ if money is borrowed for 6 months? For 3 months?

■ **Interest rates are always for one year unless stated otherwise.**

4. Mr. Camp borrowed $400 at 5% for $2\frac{1}{2}$ yr. Find the interest.

THINK: $i = \$400 \times .05 \times 2\frac{1}{2} = ?$

5. Bruce borrowed $60 at 6% for 6 mo. Find the interest.

THINK: $i = \$60 \times .06 \times \frac{1}{2} = ?$

*Use the formula to find the interest on the following.*

6. $4500 at 4% for 2 years
7. $100 at 7% for 3 years
8. $580 at 6% for 2 years
9. $120 at 5% for 6 years
10. $700 at 3% for $2\frac{1}{2}$ years
11. $1250 at 6% for $1\frac{1}{2}$ years
12. $6000 at 4% for $3\frac{3}{4}$ years
13. $1200 at $4\frac{1}{2}$% for 2 years
14. $3200 at $6\frac{1}{4}$% for 3 years
15. $4500 at $2\frac{1}{2}$% for 4 years

16. Ted borrowed $125 at 6% for 4 months. Find the interest.

THINK: 4 mo. $= \frac{4}{12} = \frac{?}{3}$ yr.
$i = \$125 \times .06 \times \frac{1}{3} = ?$

▶ Businesses use these time measures in figuring interest:

30 days = 1 business month
360 days = 1 business year
12 months = 1 year

17. Mr. Thomas borrowed $1500 for 90 days at 6% interest. Find the interest.

THINK: 90 days $= \frac{90}{360} = ?$ yr.

18. Mr. Jonas borrowed $2700 for 20 days at $6\frac{1}{2}$% interest. Find the interest.

THINK: 20 days $= \frac{20}{360} = ?$ yr.

*Write each of these as a fractional part of a business year.*

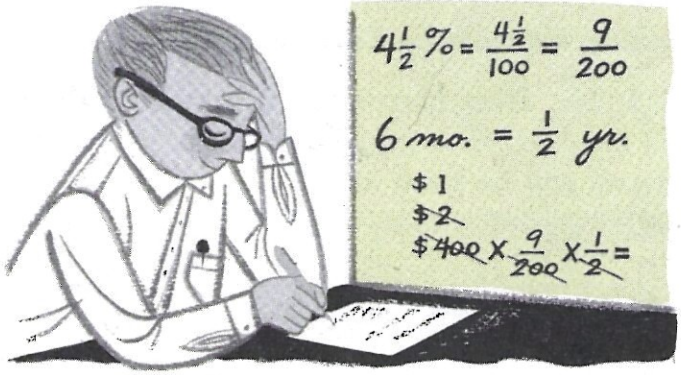
19. 5 mo. 10 mo. 9 mo.
20. 24 days 60 days 90 days

*Find the interest.*

21. $300 at 4% for 3 months
22. $750 at 6% for 8 months
23. $540 at $5\frac{1}{2}$% for 100 days
24. $2000 at $3\frac{1}{2}$% for 30 months
25. $1500 at 4% for 90 days

### Canceling as a Short Cut

1. Mr. Bond borrowed \$400 at $4\frac{1}{2}\%$ for 6 months. Explain his figuring. Copy and complete his work. If you understand what you are doing, canceling can become a good short cut.




*Change to common fractions.*

2. $3\frac{1}{2}\%$ $5\frac{1}{2}\%$ $7\frac{1}{2}\%$ $1\frac{1}{2}\%$ $2\frac{1}{2}\%$
3. $2\frac{1}{4}\%$ $6\frac{1}{4}\%$ $3\frac{3}{4}\%$ $1\frac{7}{8}\%$ $6\frac{2}{3}\%$

*Use canceling to find the interest on the following.*

4. \$120 at $3\frac{1}{2}\%$ for 6 months
5. \$720 at $2\frac{1}{4}\%$ for 4 months
6. \$4000 at $2\frac{1}{2}\%$ for 3 months
7. \$6400 at $7\frac{1}{2}\%$ for 5 months
8. Mr. Hall borrowed \$300 at 4% for 27 days. Find the interest.
THINK: 27 days = ? yr.

*Use canceling to find the interest on the following.*

9. \$500 at 3% for 60 days
10. \$600 at 6% for 30 days
11. \$500 at 4% for 18 days
12. \$250 at 3% for 60 days
13. \$240 at 5% for 72 days
14. Mr. Smith borrowed \$246 at $3\frac{1}{2}\%$ for 3 months. Find the interest and round the amount to the nearest whole cent.

*Find the interest. Round to the nearest whole cent.*

15. \$450 at $2\frac{1}{4}\%$ for 45 days
16. \$975 at $3\frac{1}{2}\%$ for 18 days
17. \$342 at 4% for 24 days
18. \$171 at $2\frac{1}{2}\%$ for 36 days
19. Miss Jones has \$1200 to invest. A savings bank will pay 2% interest. How much interest is this for 1 year?
20. Miss Smith invested \$1200 in a cottage. She rented it for \$30 a month. It cost her \$240 a year for taxes and repairs. What was her profit per year?

Miss Smith said that her profit was 10% of her investment. Prove that this is correct.

21. Mr. Dodson borrowed \$2000 to buy a grocery store. At 6%, what was the interest per year?

Mr. Dodson made a profit of \$2897.75 the first year. After paying the principal and interest, how much did he have left?

## Percentage Formulas

1. Oscar had \$168. He spent 25% of it. How much did he spend?

Are you asked to find the whole amount, rate, or a part? Which number is each of these?

2. Think what you did to work problem 1. Refer to the rule given on page 100 for finding a per cent of a number. Explain this formula:

$p\,(part) = r\,(rate) \times w\,(whole)$ or $p = rw$

3. Mr. Fay borrowed \$200 at 6% interest. Use the formula to find the interest he paid annually.

4. A suit regularly priced at \$75 was sold at a 20% discount. What is the amount of the discount?

5. Dorcas had \$84, of which she spent \$21 for a dress. What per cent of the money did she spend?

Are you asked to find the whole amount, rate, or a part? Which number is each of these?

6. Think what you did to work problem 5. Refer to the rule given on page 103 for finding what per cent one number is of another number. Explain this formula:

$r = p \div w$ or $r = \frac{p}{w}$

7. Mr. Carr borrowed \$300. The interest was \$15 per year. Use the formula to find the rate (per cent) of interest.

8. Mary sold \$24 worth of vegetables. Her commission was \$3. What was the rate of commission?

9. Henry borrowed some money from his father. His father charged him only 1% interest. How much had he borrowed, if he paid \$.75 interest?

THINK: 1% of ? is \$.75

100% of ? is $100 \times \$.75$

Are you asked to find the whole amount, rate, or a part? Which number is each of these?

10. Do problem 9 again, using this formula:

$w = p \div r$ or $w = \frac{p}{r}$

11. Mr. Davis borrowed money at an interest rate of 4%. He paid \$16 a year as interest. Use the formula to find out how much he had borrowed.

12. George sells brushes at 15% commission. He earned \$90 last week. What were his total sales last week?

13. Mary had \$450. She spent 5% of it. How much did she spend?

14. Ann had \$140. She spent \$4.20. What per cent of her money did she spend?

## Baseball Standings

1. When the teacher asked the students to bring to class newspaper clippings that contained per cents, Tim brought the baseball standings at the right.

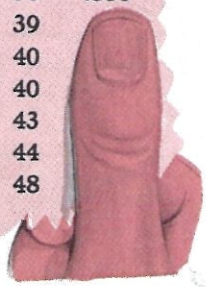
Tim explained that baseball standings are often called "percentages," but that they really are written as decimals, given in thousandths.

Explain why Brooklyn's record of 56 wins and 24 losses is a standing of .700. Why is Chicago's standing .550?

THINK: How many games did each team play in all?

LEAGUE STANDINGS

| TEAM | WON | LOST | STDG. |
|---|---|---|---|
| Brooklyn | 56 | 24 | .700 |
| Chicago | 44 | 36 | .550 |
| Milwaukee | 39 | 39 | |
| Cincinnati | 38 | 40 | |
| New York | 37 | 40 | |
| St. Louis | 36 | 43 | |
| Philadelphia | 34 | 44 | |
| Pittsburgh | 30 | 48 | |



2. What per cent are Brooklyn's wins of its total games played? Is this the same as .700?

3. What per cent are Chicago's wins of its total? Does this equal .550?

4. What fraction of its games did Milwaukee win? What per cent is this? What decimal?

5. What fraction of its games did Cincinnati win? Change this fraction to a decimal correct to the nearest thousandth. What did you do with the 1 in the fourth decimal place of your division?

6. Find the standing of the New York team. What did you do with the 5 in the fourth decimal place when you rounded to thousandths?

7. Find the standings of the three other teams, correct to the nearest thousandth.

8. Arrange these softball teams according to standing. Put the team with highest standing first.

| TEAM | WON | LOST | TEAM | WON | LOST |
|---|---|---|---|---|---|
| Bears | 18 | 14 | Turks | 17 | 12 |
| Lions | 19 | 13 | Blues | 16 | 16 |
| Hawks | 12 | 20 | Crows | 15 | 17 |

9. Batting averages are figured like team standings. If Tom made 3 hits in 8 times at bat, what is his batting average?

*Find these batting averages.*

10. 135 times at bat, 64 hits.
11. 109 times at bat, 48 hits.
12. 123 times at bat, 29 hits.
13. 118 times at bat, 41 hits.

## More about Discounts

1. Joel saw the bill at the right on his father's desk. Explain what is meant by *net* price. Prove that the discount is figured correctly. How much would Joel's father have paid without the cash discount?

| QUANTITY | DESCRIPTION | PRICE |
|---|---|---|
| 3 ton | No. 2 Stoker Coal @ $13.00 | $39.00 |
| | Less 2% cash discount | .78 |
| | NET PRICE (if paid within 10 days) | $38.22 |

2. A lamp regularly priced at $30 was sold at a discount of 20%. How much is the discount? What is the net price.

*Find the net prices. Regular prices and the rates of discount are given.*

| | a | b |
|---|---|---|
| 3. | $260; 40% | $150; 25% |
| 4. | $1.44; $12\frac{1}{2}\%$ | $132; $16\frac{2}{3}\%$ |
| 5. | $165; $33\frac{1}{3}\%$ | $640; $37\frac{1}{2}\%$ |
| 6. | $336; $6\frac{1}{4}\%$ | $970; 50% |

7. Dealers often get two or more discounts on goods they buy. A TV dealer got discounts of 25% and $16\frac{2}{3}\%$ on a tube costing $6. What was his net price? Notice how the dealer figured the discounts.

| | |
|---|---|
| List Price | $6.00 |
| First Discount (25% of $6.00) | −1.50 |
| | $4.50 |
| Second Discount ($16\frac{2}{3}\%$ of $4.50) | −.75 |
| Net Price | ? |

8. The list price of a sweeper is $75. What is the net price for a dealer who gets discounts of 16% and 12%.

*Find net prices. List prices and rates of discount are given. Be sure to figure the second discount correctly.*

| | | | |
|---|---|---|---|
| 9. | $750; | 20%; | 10% |
| 10. | $60; | 25%; | 20% |
| 11. | $960; | $33\frac{1}{3}\%$; | $12\frac{1}{2}\%$ |
| 12. | $500; | 30%; | 8% |

*Find (a) regular price, (b) sale price, (c) rate of discount, and (d) amount of discount.*

13. A $60 suit selling for $48.

14. $16\frac{2}{3}\%$ discount on a $15 hat.

15. $3 saving on hat marked 20% off.

16. Saving of $4 on $12 shoes.

## How Well Have You Learned?

1. Write as decimals.

   4% 30% $62\frac{1}{2}\%$ 125%

2. Write as per cents.

   .32 2.5 $\frac{3}{4}$ $\frac{3}{20}$

*Find the following.*

3. 5% of \$72 $6\frac{1}{4}\%$ of 112
4. $37\frac{1}{2}\%$ of 60 $8\frac{1}{3}\%$ of 72
5. 125% of 64 $4\frac{1}{2}\%$ of \$360

*Find what per cent the first number is of the second number.*

6. 60; 240 60; 450
7. 75; 600 75; 450
8. 120; 600 120; 80

*Find the missing numbers.*

9. 6% of ☐ = 30
10. $16\frac{2}{3}\%$ of ☐ = 15
11. 125% of ☐ = 40

12. A salesman sold goods for \$375. His rate of commission was 8%. What was the amount of his commission?

13. The regular price of a rug was \$175. The sale price was 20% less than the regular price. Find the sale price.

14. Mr. Ferris paid \$12,500 for a home. He sold it for 12% more than he paid for it. Find the selling price.

15. Find the interest on —

    \$320 at 5% for 2 years

    \$450 at 6% for 6 mo.

    \$610 at 4% for 9 mo.

16. There were 243 items on an army test. Joe got 187 of them correct. What per cent did Joe get right? Find the answer correct to the nearest whole per cent.

17. A batter made 43 hits out of 167 times at bat. Find his batting average as a decimal correct to thousandths.

18. The regular price of a suit was \$87.50. The sale price was \$70. Find the per cent of the discount.

19. Anna paid \$2.25 for a scarf. This was 75% of the regular price. Find the regular price.

20. A dining-room suite costing \$109.50 was sold for \$172. The transportation costs were \$18.75. What was the margin?

21. A radio dealer received discounts of 20% and 10% on a radio priced at \$46. The set sold for \$51. What was the margin?

## Help Yourself to Improve

1. Explain each of the following terms: (101, 106, 109, 114)

| | |
|---|---|
| Rate of commission | Profit |
| Amount of commission | Margin |
| | Principal |
| Rate of discount | Overhead |
| Rate of interest | Cost |

*Make up an example of each of the following types:*

2. Finding a per cent of a number. (100)

3. Finding what per cent one number is of another number. (102)

4. Finding a whole from a part. (108)

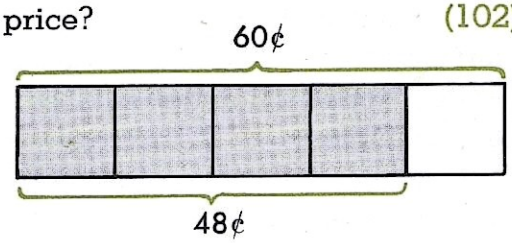
5. Ten years ago the population of Alton was 1250. The population has increased 24%. What is the population now? (100)

6. Ten years ago the population of Maryville was 1500. The population has decreased 24%. What is the population now? (100)

7. The price of eggs increased from 40¢ a dozen to 50¢ a dozen. Find what per cent the increase is of the original price. (102)

8. The price of beef decreased from 52¢ per pound to 48¢ per pound. Find what per cent the decrease is of the original price. (102)

9. On January 15 the price of oranges was 60¢ per dozen. Six months later the price was 48¢ per dozen. The amount of the decrease was what per cent of the January price? (102)




10. A house that was advertised for sale at $16,400 was not sold. The next year the same house was offered for sale at $14,350. The new price is what per cent less than the original price? (102)

11. Find the rate of interest when the amount of interest is $7.20 and the principal is $180. (117)

12. Mr. Hall's wages were $60 a week. He got an increase of 20%. What were his wages then? (100)

13. June spent 75% of her money. She has $6 left. How much money did she have in the beginning? (108)

14. The Blair Department Store bought a bed for $45. The transportation cost and the overhead totaled $15. The bed was sold for $75. What was the per cent of profit over the cost? (109)

## Show That You Know

Write the numbers 1-18 in a column. If one of the three numbers after an example is the correct answer, write that number on your answer sheet after the number of the example. If none of the three numbers is the correct answer, write "None" after the number of the example.

1. Write $16\frac{2}{3}\%$ as a fraction in lowest terms.

   $\frac{1}{16}$ $\frac{1}{3}$ $\frac{1}{6}$ None

2. Write $\frac{3}{8}$ as a per cent.

   30% $37\frac{1}{2}\%$ 38% None

3. Write .3 as a per cent.

   .3% 3% 30% None

4. Write $\frac{7}{8}$ as a decimal.

   .835 .780 .875

5. What per cent of 30 is 12?

   12% 30% 40% None

6. Find 15% of 60.

   4 9 15 None

7. 12 is 15% of what number?

   8 18 80 None

8. $6\frac{2}{3}\%$ is equal to what fraction?

   $\frac{1}{12}$ $\frac{1}{15}$ $\frac{1}{16}$ None

9. 6% of what number is 30?

   5 180 500 None

10. 15 is what per cent of 60?

    4 25 40 None

11. The regular price of a coat is $20. The sale price is $17.50. The rate of discount is —

    $12\frac{1}{2}\%$ 20% 25% None

12. All coats were on sale at 25% off regular price. The sale price of one coat was $30. What had been the regular price?

    $45 $40 $37.50 None

13. Jean earns $40 a week plus a commission of 3% of her sales. One week her sales were $720. How much did she earn that week?

    $61.60 $72 $120 None

14. Find the interest on $240 at 2% for 5 months.

    $48 $24 $2 None

15. Find the rate of interest: Principal - $520; Interest - $26.

    50% 5% $5\frac{1}{2}\%$ None

16. A real estate company sold a home for $13,500. The rate of commission was $2\frac{1}{2}\%$. What was the amount of the commission?

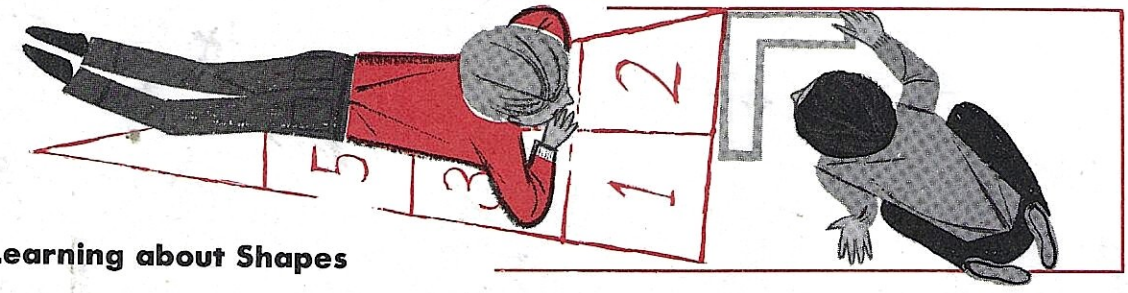
    $135 $250 $270 None

17. Ted's team won 2 games and lost 6. What was its standing?

    .333 .250 30% None

18. $12\frac{1}{2}\%$ of what number is $10?

    $1.25 $80 $125 None




## Learning about Shapes

1. When Mark tried to lay out a shuffleboard court, every triangle that he sketched on the floor seemed to be lopsided. Art suggested that perhaps they should read the directions again to be sure they knew what was meant. Why was this a good idea?

2. The directions made it clear that the bottom, or *base*, of the triangle had to be *perpendicular* to the sides of the court. This means that the corners had to be square. The boys agreed that the corners looked square to them. Were they sure that the lines were perpendicular?

3. When Mark got a carpenter's square from his father's workbench, it was easy to see that the lines were not perpendicular. Why would the square show this?

4. The directions said that the angles at each end of the base were to be 71 degrees. The pictures at the bottom of the page show the steps in using a protractor to draw such an angle. Explain each step.

5. If the boys had not had the carpenter's square, how could they have used the protractor to draw perpendicular lines?

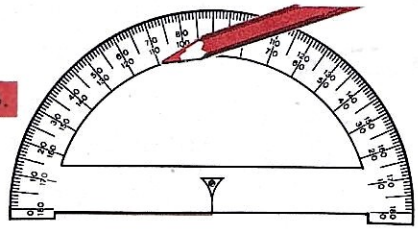
6. Make a list of things, such as a wheel or a full moon, which have the shape of a circle.

7. List objects that have a square shape.

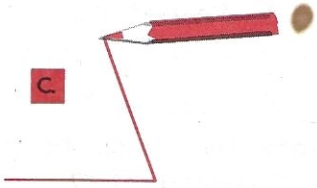
8. List objects that have the shape of a triangle.

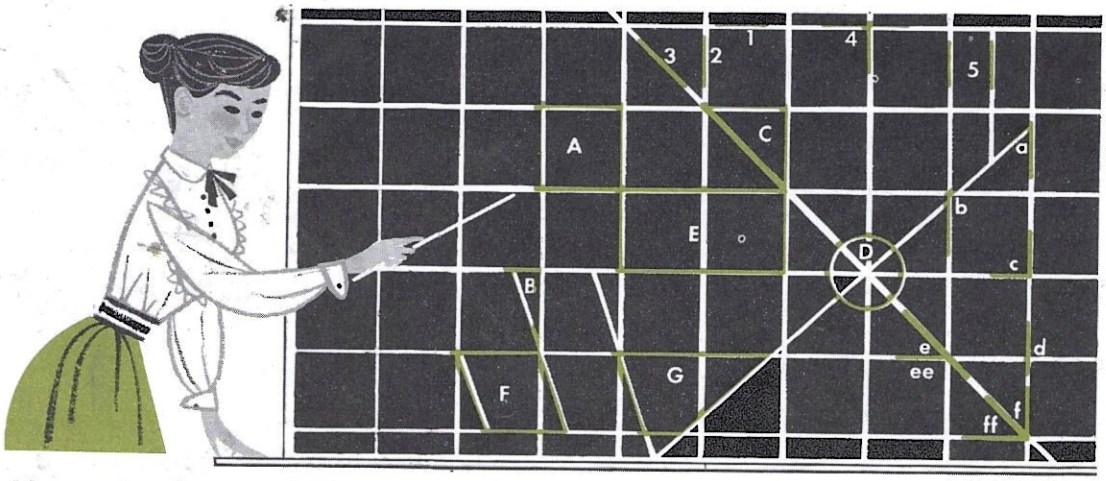
A.

B.



C.






**Lines, Angles, and Shapes**

1. When the arithmetic class of the seventh grade began to study lines, shapes, and angles, Marilyn made a copy of a map of a section of the city. Other members of the class used colored chalk to mark and label various kinds of lines, shapes, and angles. Which can you identify?

*Find each of the following lines on the map above.*

2. A *horizontal* line is one which is level with the horizon.

3. A *vertical* line is one which is straight up and down.

4. An *oblique* line is one which slants or leans.

5. *Perpendicular* lines are lines which meet at right angles.

6. *Parallel* lines are lines which are the same distance apart at all points.

*Find each of the following angles on the map above.*

7. A *right angle* is an angle which has 90°. (The sign ° is read degrees.)

8. An *acute angle* is an angle which has less than 90°.

9. An *obtuse angle* is an angle which has more than 90°.

10. A *straight angle* is an angle which has 180° (a straight line).

11. Two angles are *complementary* if their sum is 90 degrees.

12. Two angles are *supplementary* if their sum is 180 degrees.

*Find each of the following shapes on the map above.*

13. All points of a *circle* are equally distant from its center.

14. A *rectangle* is a four-sided

figure which has four right angles.

**15.** A *square* is a four-sided figure which has four right angles and four equal sides.

**16.** A *parallelogram* is a four-sided figure in which the opposite sides are parallel.

**17.** A *trapezoid* is a four-sided figure with one set of opposite sides parallel.

**18.** A *right triangle* is a three-sided figure with one right angle.

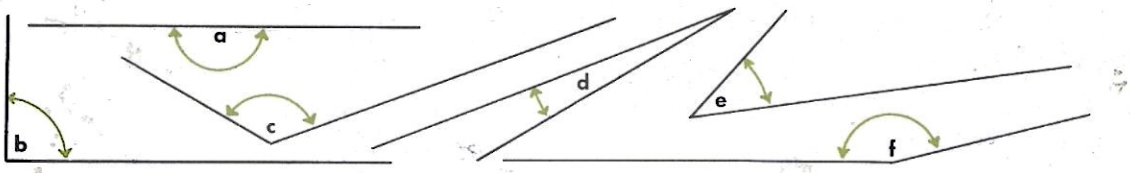
**19.** An *isosceles triangle* is a three-sided figure in which two sides are of equal length.

**20.** According to the definitions, can a square be classed as a rectangle? Why? As a parallelogram? Why?

**21.** Can a rectangle be classed as a parallelogram? Why? Can a parallelogram be classed as a rectangle? Why?

**22.** On the map on the opposite page, triangle C is an isosceles triangle. Is it also a right triangle? Why? Are all isosceles triangles right triangles? Are all right triangles isosceles triangles? Draw triangles to prove each of your answers.

## Measuring and Drawing Angles




**1.** Use a protractor to measure each of the angles above. List the angles and the number of degrees in each according to size, beginning with the smallest angle.

**2.** Which of the angles above is an acute angle? Which is a straight angle? An obtuse angle? A right angle?

**3.** Draw an angle of 90°. Use a protractor to divide it into three equal angles. How many degrees are there in each angle?

**4.** Draw an angle of 60°. Use a protractor to divide it into two equal angles.

**5.** Draw two angles that are complementary. Make one of them 35°. How large is the other angle?

**6.** Draw two angles that are supplementary. Make one of them 100°. How large is the other angle?

## Drawing Simple Shapes

1. Mary drew a pattern for a patchwork quilt. She needed several squares 2 inches on a side. Draw a square for this pattern.

2. Draw a pattern for a rectangular patch 3 inches long and 2 inches wide. How many degrees are in each angle?

3. Draw a pattern for a triangle with each side equal to 3 inches and each angle equal to 60°. A triangle with three equal sides is called an *equilateral triangle*.

4. Draw a parallelogram with sides 4 inches and 3 inches, and with angles of 60° and 120°.

5. Draw an isosceles triangle with the base 3 inches and with the angles at the ends of the base each equal to 50°.

6. Draw a trapezoid with the lower base equal to 5 inches, angles at each end of the base equal to 60°, and the end (oblique) lines each 3 inches long.

7. Draw a triangle with the base equal to 3 inches, the angle at one end of the base equal to 90°, and the angle at the other end of the base equal to 60°. What kind of triangle is this? How large is the third angle?

8. The carpenter in the picture is using a plumb line. What does it tell him about the post? What kind of a line is a plumb line? (See page 124.) Are all vertical lines parallel to each other? Point out several vertical lines in the classroom.

9. What kind of line would be made by a straw floating on a bowl of water? Are all horizontal lines parallel to each other? May two horizontal lines be perpendicular to each other? Point out horizontal lines in the classroom.

10. Point out several oblique lines in the classroom. May two oblique lines be parallel? May two oblique lines be perpendicular?

11. Point out several right angles, acute angles, and obtuse angles.

12. Describe the sides (tell whether they are equal, parallel, perpendicular, etc.) and the angles (size or kind) of the following:

a. Square b. Parallelogram
c. Rectangle d. Trapezoid
e. Equilateral triangle
f. Isosceles triangle
g. Right triangle

## No Pencils, Please

Per cents are very important in arithmetic and in your everyday life. This page will help you review the uses of per cents.

Remember to use your pencil only to write answers.

*Change to per cents.*

1. .04 .40 .4 $.07\frac{1}{2}$ $.16\frac{2}{3}$
2. $\frac{1}{4}$ $\frac{3}{4}$ $\frac{1}{2}$ $\frac{2}{5}$ $\frac{3}{10}$

*Change to decimals.*

3. 6% 16% 60% $3\frac{1}{2}\%$ $2\frac{3}{4}\%$

*Change to fractions.*

4. 20% 25% 10% 5% 4%
5. $12\frac{1}{2}\%$ $6\frac{1}{4}\%$ $37\frac{1}{2}\%$ $16\frac{2}{3}\%$ $33\frac{1}{3}\%$

*Choose the fraction and decimal equivalents.*

6. $12\frac{1}{2}\%$ ($\frac{1}{6}$; $\frac{1}{8}$; $.12\frac{1}{2}$; $.012\frac{1}{2}$)
7. $6\frac{1}{4}\%$ ($\frac{1}{12}$; $\frac{1}{16}$; $.6\frac{1}{4}$; $.06\frac{1}{4}$)
8. $2\frac{1}{2}\%$ ($\frac{1}{4}$; $\frac{1}{40}$; $.2\frac{1}{2}$; $.02\frac{1}{2}$)
9. $37\frac{1}{2}\%$ ($\frac{1}{3}$; $\frac{3}{8}$; $.37\frac{1}{2}$; .375)
10. $8\frac{1}{3}\%$ ($\frac{1}{12}$; $\frac{1}{16}$; $.8\frac{1}{3}$; $.08\frac{1}{3}$)

*Find what per cent the red number is of each of the other numbers in its row.*

| | | | | | |
|---|---|---|---|---|---|
| 11. | 16 | 15 | 18 | 20 | 12 |
| 12. | 30 | 45 | 20 | 50 | 15 |
| 13. | 15 | 30 | 16 | 20 | 10 |
| 14. | 18 | 45 | 90 | 10 | 9 |
| 15. | 24 | 96 | 80 | 10 | 10 |
| 16. | 100 | 200 | 250 | 320 | 16 |

*Find these amounts.*

17. 5% of \$200 10% of \$50
18. 25% of \$160 50% of \$60
19. $12\frac{1}{2}\%$ of \$24 $16\frac{2}{3}\%$ of \$48

*Find these whole numbers.*

20. $\frac{1}{3}$ of ? = 6 $\frac{2}{3}$ of ? = 6
21. .2 of ? = 8 .25 of ? = 5
22. 50% of ? = 7 25% of ? = 9
23. 75% of ? = 9 6% of ? = 12
24. 4% of ? = 12 60% of ? = 12

*Find these discounts. The figures give the regular price and the rate of discount.*

25. \$625; 4% \$12,000; 5%
26. \$800; $2\frac{1}{2}\%$ \$800; $6\frac{1}{4}\%$
27. \$75; 20% \$60; 15%
28. \$50; 12% \$60; $33\frac{1}{3}\%$

*Find the interest on the following. The figures give the principal, the rate of interest, and the time.*

29. \$200; 6%; 1 yr. \$50; 4%; 6 mo.
30. \$300; 5%; 2 yr. \$60; 4%; 3 mo.

## More Shapes and Angles

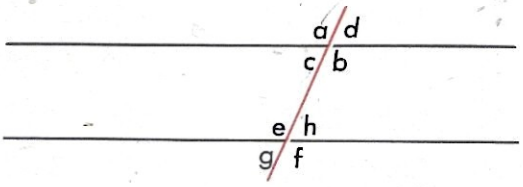
1. Draw a right triangle and measure each angle. How many degrees are there in all three angles together?

2. Draw an isosceles triangle. How many degrees in all 3 angles?

3. Measure the angles of several other triangles to find the number of degrees in all 3 angles of each triangle. Make a rule which will apply to any triangle.

4. Draw a square, a rectangle, a parallelogram, a trapezoid, and an odd-shaped figure with four sides. What is the total number of degrees in all 4 angles of each figure? Make a rule that will apply to any 4-sided figure.

5. In the figure below, two parallel lines are cut by a third line. All angles are labeled.




Name several pairs of angles that are equal in size. Name several pairs of supplementary angles.

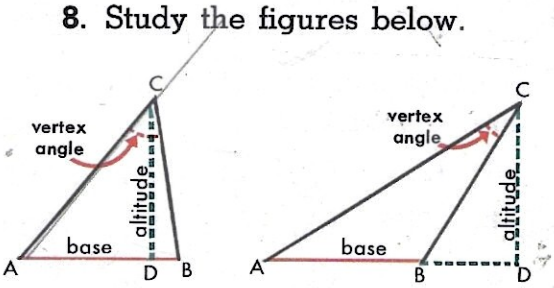
An *acute triangle* is any triangle in which all three angles are acute.

6. Draw an acute triangle. Is a right triangle an acute triangle? Is an equilateral triangle an acute triangle? Draw triangles to prove your answers.

An *obtuse triangle* is any triangle which has one obtuse angle.

7. Draw an obtuse triangle. Is a right triangle an obtuse triangle? Is an equilateral triangle an obtuse triangle? May an isosceles triangle be an obtuse triangle? Draw triangles to prove your answers.

8. Study the figures below.




In each figure, measure angle *ADC*. This means that the height or altitude of a triangle is ⍰ to the base. Notice where the altitude of the obtuse triangle must be drawn in order to have it perpendicular to the base.

The figures above show that the *vertex angle* of a triangle is the angle opposite the ⍰.

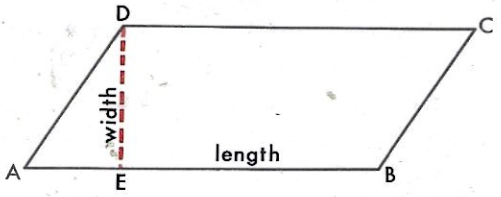
9. Draw an acute triangle with a base of 3 inches and an altitude of $2\frac{1}{2}$ inches. Will all acute tri-

angles with these measurements have the same shape? Prove.

**10.** Draw an obtuse triangle with a base of 3 inches and an altitude of $2\frac{1}{2}$ inches. Will all obtuse triangles with these measurements have the same shape? Prove your answer with drawings.

**11.** Draw a rectangle 3 inches long and $2\frac{1}{2}$ inches wide. Will all rectangles with these measurements have the same shape? Prove with drawings.

**12.** Study the figure below.




Measure angle *AED*. This means that the width of a parallelogram is a ? line drawn from one long side to the other. Measure the length *(AB)* and the width *(DE)* of the figure.

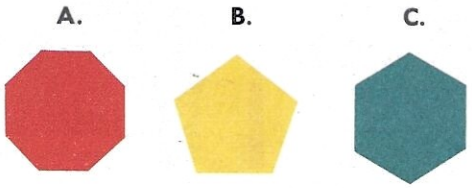
**13.** Draw a parallelogram with a length of 3 inches and a width of $1\frac{3}{4}$ inches. Will all parallelograms with these measurements have the same shape? Prove with drawings.

*Match these definitions with the three figures that follow:*

**14.** A regular *pentagon* has 5 equal sides and 5 equal angles.

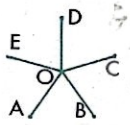
**15.** A regular *hexagon* has 6 equal sides and 6 equal angles.

**16.** A regular *octagon* has 8 equal sides and 8 equal angles.




**17.** Study the figure at the right. How many triangles make up a pentagon? How many degrees are there in the vertex angle of each triangle (at point *O*)? The whole turn around *O* is 360°. Then, the vertex angle of each triangle is $360° \div 5 = ?$.

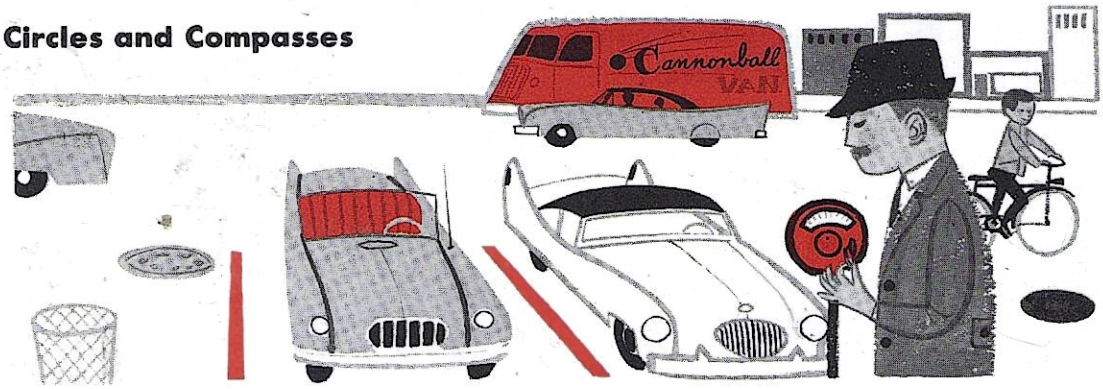
**18.** Use a protractor to help draw five 72-degree angles around a point *O* as at right. Draw *OA*, *OB*, *OC*, *OD*, and *OE*, each equal to 2 in. How can you complete the pentagon?




**19.** How many triangles are in a hexagon? How many degrees will be in each vertex angle? Draw a hexagon.

**20.** How many triangles are in an octagon? How many degrees will be in each vertex angle? Draw an octagon.

## Circles and Compasses

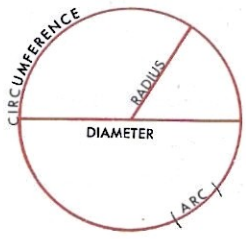


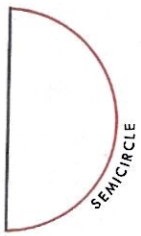

1. Almost anywhere you look, you can see circles. How many can you find in the drawing above?

2. Can you get a circle by drawing around a coin? Think of several other ways in which you could draw circles. How could you draw a circle that measures 15 feet across?

3. Explain how compasses are used to draw a circle. See the picture at the left.

4. A circle and its parts have names. For example, a *circle* is the line that makes the ring. Study the figures below and explain what each of the terms means.




■ **A circle is a ring which is the same distance from its center at all points.**

- **Circumference is the distance around the circle.**
- **A diameter is a straight line through the center of a circle, joining two points on the circle.**
- **A radius is a straight line from the center to any point on a circle.**
- **An arc is any part of a circle.**
- **A semicircle is half a circle.**

5. Which is longer, the radius or the diameter of a circle? How many times as long is it?

6. Explain this statement: A diameter of a circle is equal to two radii. (*Radii* is the plural of *radius*.)

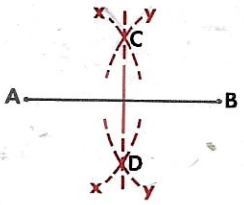
7. Explain this statement: A diameter of a circle divides the circle into two semicircles.

8. When the points of the compasses are one inch apart, what

will be the radius of a circle drawn with the compasses? The diameter?

9. Draw circles with radii of $2\frac{1}{2}$ in., $1\frac{3}{4}$ in., and 2 in. What is the diameter of each circle?

Compasses can be used to find the middle of a line, or to *bisect* a line. Explain the drawing below. Notice that arcs $x$ have $A$ as center and that arcs $y$ have $B$ as center. The radii of all the arcs are the same.

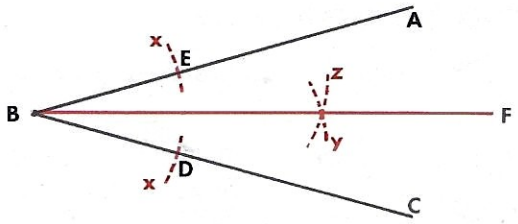



10. Could you bisect line $AB$ if the radius of the arcs were less than half the length $AB$? Draw figures to find out what would happen.

11. Draw a line about 3 inches long. Use compasses and a ruler to bisect the line. Use the ruler only for drawing the straight lines.

12. Draw and bisect lines of these lengths: $3\frac{1}{2}$ in.; $4\frac{1}{8}$ in.; $5\frac{3}{4}$ in.

We *bisect* an angle when we draw a line which cuts an angle into two equal parts. Explain how angle $ABC$ at the top of the next column was bisected. Notice that




arcs $x$ have $B$ as center, and that arcs $y$ and $z$ have $D$ and $E$ as centers. ($y$ and $z$ have the same radius.)

13. Use a protractor to draw an angle of 60°. Bisect the angle with compasses. Measure each part of the bisected angle. Is each part equal to 30°?

14. Cut out an angle you have bisected. Fold it along the bisecting line. How will this prove whether or not you have bisected the angle?

15. Draw an obtuse angle and use compasses to bisect it. Prove by measuring with a protractor and by cutting and folding that the bisecting line has cut the angle into two equal parts.

16. Draw five angles of any size and use compasses to bisect them. Prove by cutting out and folding that they have been bisected.

17. Draw five lines of any length and use compasses to bisect them. Prove by measuring with a ruler that they have been bisected.

## Mixed Practice

*Do what the signs tell you to do.*

| | | | | |
|---|---|---|---|---|
| 1. | 48<br>37<br>84<br>73<br>94<br>+67 | 563<br>99<br>664<br>187<br>76<br>+238 | 4018<br>5549<br>7707<br>886<br>1549<br>+574 | 86540<br>6473<br>15430<br>594<br>88<br>+66106 |
| 2. | $3\frac{1}{2}$<br>$2\frac{1}{4}$<br>+8 | $8\frac{3}{4}$<br>$3\frac{1}{3}$<br>$+2\frac{1}{2}$ | $14\frac{5}{6}$<br>$8\frac{2}{3}$<br>$+21\frac{3}{8}$ | $37\frac{1}{6}$<br>$19\frac{1}{3}$<br>$+37\frac{1}{2}$ |
| 3. | 6.5<br>1.3<br>.8<br>1.8<br>+.6 | .38<br>.21<br>.40<br>.62<br>+.07 | 4.19<br>1.61<br>.67<br>5.90<br>+.19 | 28.06<br>.18<br>8.59<br>37.87<br>+8.63 |
| 4. | 70<br>−17 | 512<br>−84 | 5101<br>−666 | 40321<br>−9400 |
| 5. | $6\frac{1}{4}$<br>$-\frac{1}{2}$ | $65\frac{1}{2}$<br>$-5\frac{3}{4}$ | $120\frac{3}{8}$<br>$-6\frac{2}{3}$ | $675\frac{1}{6}$<br>$-37\frac{1}{2}$ |
| 6. | 8.1<br>−.6 | .90<br>−.08 | 31.0<br>−15.2 | 54.31<br>−8.25 |
| 7. | 73<br>×20 | 507<br>×54 | 9103<br>×610 | 75625<br>×708 |
| 8. | 64<br>$\times 7\frac{1}{4}$ | 348<br>$\times 12\frac{1}{2}$ | $468\frac{2}{3}$<br>×72 | $724\frac{5}{8}$<br>×64 |
| 9. | 4.5<br>×.8 | .78<br>×.5 | 4.32<br>×2.5 | .6484<br>×7.5 |

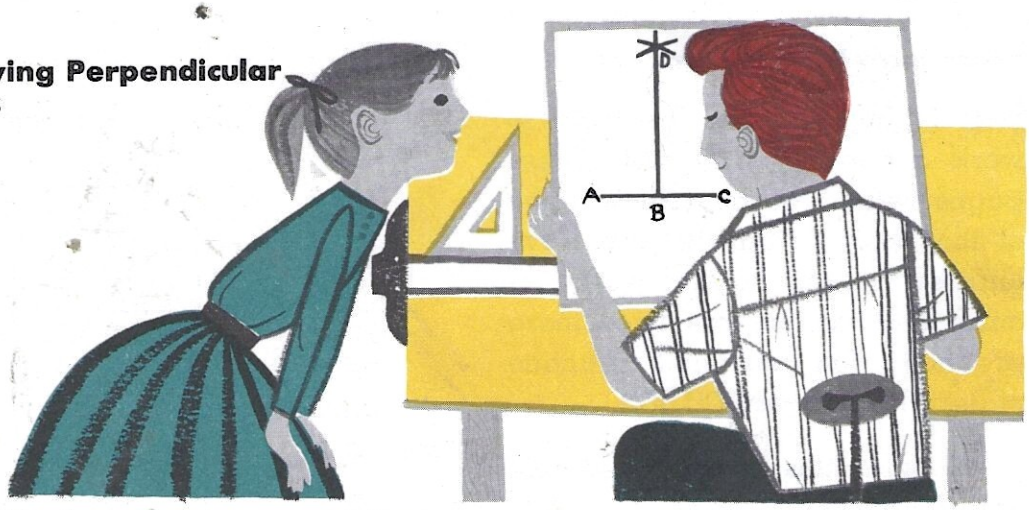
| | | |
|---|---|---|
| 10. | 39760 ÷ 560 | 48312 ÷ 732 |
| 11. | 47310 ÷ 83 | 23688 ÷ 47 |
| 12. | $231 \div 3\frac{1}{7}$ | $37\frac{1}{2} \div 4$ |
| 13. | $12\frac{1}{2} \div 3\frac{3}{4}$ | $200 \div 16\frac{2}{3}$ |
| 14. | 197.57 ÷ 8.59 | 1160.3 ÷ .41 |
| 15. | 13.803 ÷ 12.9 | 1.5639 ÷ .39 |

| | | | |
|---|---|---|---|
| 16. | $ 12.53<br>6.67<br>37.45<br>335.80<br>67.65<br>+45.75 | $163.12<br>49.40<br>8.19<br>234.40<br>29.10<br>+287.25 | $ 97.50<br>130.60<br>56.34<br>11.18<br>100.00<br>+89.90 |
| 17. | $20.00<br>−8.75 | $450.60<br>−68.75 | $322.50<br>−18.00 |
| 18. | $18.75<br>×8 | $119.40<br>×24 | $467.50<br>×324 |
| 19. | $8\overline{)\$6}$ | $16\overline{)\$24}$ | $\$.03\overline{)\$3}$ |

20. $4.80 + $1 + $3.75 + 50¢ + $2
21. 95¢ + $.60 + $4 + $.30 + $3
22. $57 + $6.70 + $8 + $15 + $.75
23. $9 + $4.50 + 50¢ + 60¢ + $7

| | | |
|---|---|---|
| 24. | $4 − 40¢ | $7.50 − $5 |
| 25. | $18 − $6.75 | $10 − $.85 |
| 26. | 6 × $.45 | 16 × 60¢ |
| 27. | $2\frac{1}{2} \times$ $14 | $6\frac{1}{4} \times 72¢$ |
| 28. | $24 \div 7\frac{1}{2}$ | $2.25 \div 6\frac{1}{4}$ |
| 29. | $30 ÷ 75¢ | $2.25 ÷ $3 |

## Drawing Perpendicular Lines

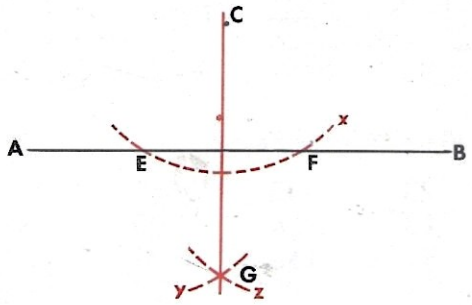



1. May's father is an architect. One day, when she visited his studio, he asked her to watch him draw a line perpendicular to one he had already drawn. Study the picture above and try to explain what he did.

2. A straight line is really an angle. What kind? How many degrees are in that kind of angle? How many degrees will there be in angles *ABD* and *CBD* if line *DB* is perpendicular to line *AC*? What did May's father really do to straight angle *ABC* when he drew line *DB*?

3. Draw one line. Use compasses to draw another line perpendicular to it. Use your protractor to prove that the lines are perpendicular.

4. The drawing in the next column shows you a way to draw a line through point *C* perpendicular to line *AB*. Try to explain the drawing. Notice that *C* is the center for arc *x* and that *E* and *F* are centers for arc *y* and arc *z*. Measure with a protractor to prove that line *CG* is perpendicular to *AB*.




5. Draw line *AB* and place point *C*. Use compasses to draw a line through *C* which is perpendicular to line *AB*. Prove with a protractor that your lines are perpendicular.

6. Draw three lines. Use compasses to draw a line perpendicular to each.

## Work with Whole Numbers

It is important to be able to work accurately and fast. These pages will help you review some of the basic arithmetic you have learned. If you cannot work accurately and fast, you need more practice. You will find practice material on pages 300-305.

1. Study this addition example and the checks.

| ADDITION | CHECK | CHECK | |
|---|---|---|---|
| 876 | ~~876~~ | 876 | |
| 379 | 379 | 379 | |
| 147 | 147 | +147 | |
| 902 | 902 | 902 | 1402 |
| 775 | 775 | 775 | |
| +918 | +918 | +918 | |
| 3997 | ~~3997~~ | | +2595 |
| | +876 | | 3997 |
| | 3997 | | |

*Add and check.*

| | | | | |
|---|---|---|---|---|
| 2. | 28 | 345 | 642 | 5649 |
| | 13 | 24 | 400 | 2435 |
| | 92 | 118 | 214 | 117 |
| | 37 | 89 | 107 | 9080 |
| | 78 | 154 | 99 | 948 |
| | 64 | 397 | 686 | 5409 |
| 3. | 70 | 453 | 98 | 677 |
| | 8 | 556 | 108 | 1156 |
| | 65 | 388 | 764 | 99 |
| | 43 | 13 | 582 | 567 |
| | 87 | 67 | 98 | 664 |
| | 6 | 549 | 308 | 1934 |
| | 48 | 83 | 92 | 547 |

4. Study this subtraction and the checks.

| SUBTRACTION | CHECKS | |
|---|---|---|
| 8045 | 2628 | 8045 |
| −2628 | +5417 | −5417 |
| 5417 | 8045 | 2628 |

*Subtract and check by both methods.*

| | | | | |
|---|---|---|---|---|
| 5. | 60 | 724 | 973 | 3815 |
| | 18 | 119 | 28 | 1776 |
| 6. | 71 | 437 | 506 | 4329 |
| | 8 | 154 | 9 | 653 |
| 7. | 93 | 934 | 520 | 5014 |
| | 85 | 386 | 32 | 89 |
| 8. | 51 | 703 | 802 | 7001 |
| | 48 | 258 | 16 | 6054 |

9. Study this multiplication.

| Think this: | Write this: |
|---|---|
| 328 | 328 |
| 136 | 136 |
| 1968 = 6×328 | 1968 |
| 9840 = 30×328 | 984 |
| 32800 = 100×328 | 328 |
| 44608 | 44608 |

10. Find four ways of checking multiplication. (See page 18.) Which way do you like best? Why? Multiply 78 by 46. Check in two ways.

*Multiply and check in two different ways.*

| | | | | |
|---|---|---|---|---|
| 11. | 78 | 384 | 638 | 425 |
| | 9 | 7 | 4 | 8 |
| 12. | 96 | 543 | 752 | 819 |
| | 32 | 28 | 76 | 65 |
| 13. | 84 | 763 | 892 | 640 |
| | 30 | 400 | 620 | 250 |
| 14. | 68 | 744 | 932 | 480 |
| | 50 | 205 | 407 | 608 |

15. Study and explain the division below.

| Think this: | Write this: |
|---|---|
| 54 | 54 |
| 32)1728 | 32)1728 |
| 1600 = 50×32 | 160 |
| 128 | 128 |
| 128 = 4×32 | 128 |

16. A good way to check division is to multiply the divisor by the quotient. Study this division and the check.

| DIVISION | CHECK |
|---|---|
| 67 | 57 |
| 57)3859 | ×67 |
| 342 | 399 |
| 439 | 342 |
| 399 | 3819 |
| 40 | +40 |
| | 3859 |

*Divide and check.*

| | | | |
|---|---|---|---|
| 17. | 31)2263 | 61)3233 | 73)1241 |
| 18. | 53)4187 | 43)7181 | 31)5363 |
| 19. | 67)1273 | 29)1943 | 89)2581 |
| 20. | 17)7123 | 13)9451 | 19)8417 |
| 21. | 34)1863 | 43)2964 | 56)4552 |
| 22. | 75)4630 | 86)6688 | 64)3696 |

*Do what the signs tell you to do. Check every answer.*

23. 74×83
24. 308×605
25. 63−19
26. 706−244
27. 341÷9
28. 863÷26
29. 27+604+8+560+77
30. 987+76+43+186+97

31. 8×469
32. 70×89
33. 543−76
34. 204−80
35. 774÷18
36. 983÷37
37. 4387+658+947+1059
38. 760+2006+98+1514

39. 65×804
40. 730×47
41. 345−250
42. 1003−55
43. 942÷28
44. 2432÷16
45. 19+910+3425+76+567
46. 678+54+903+167+504

## Problem Solving

There are three kinds of fraction problems —

a. Finding a fractional part of a number.
b. Finding what fractional part one number is of another.
c. Finding a whole from a part.

*Read each of the following problems and decide what kind it is. Then work the problems.*

1. Elmer had 32 rabbits. He sold $\frac{3}{8}$ of them. How many did he sell?

2. Elsie had 36 chickens. She sold $\frac{5}{6}$ of them. How many did she sell?

3. Frank had $15 and spent $6. What fractional part of his money did he spend?

4. Flora had 18 yd. of ribbon. She used 12 yd. What fractional part did she use?

5. Carol said 24 members of her class had bought class pins. This is $\frac{3}{4}$ of the whole class. How many in all are in the class?

6. Carl said there were 18 red books on the shelf. He said this was $\frac{2}{3}$ of all the books. How many books in all were on the shelf?

A decimal is just a special kind of fraction. There are three kinds of decimal problems —

a. Finding a decimal part of a number.
b. Finding what decimal part one number is of another.
c. Finding a whole from a part.

*Work as before.*

7. George had $75. He spent .3 of it. How much did he spend?

8. Gladys had 120 pages to read. She has read .25 of them. How many pages has she read?

9. A family has an income of $80 a week. They use $32 of this for food. What decimal part of its income does this family use for food?

10. Mabel earns $150 a month. Her room rent is $36 a month. What decimal part of her earnings go for room rent?

11. Henry's dues were $2.50. This was .25 of all he had. How much did he have?

12. Helen's carfare is $1.20 a week. This is .4 of her allowance. How much is her allowance?

▶ A per cent is just a special kind of decimal fraction. There are three kinds of per cent problems —

a. Finding a per cent of a number.
b. Finding what per cent one number is of another.
c. Finding a whole from a part.

*Work as before.*

**13.** Mr. Frost earns $540 a month. Jack earns 60% as much. How much does Jack earn per month?

**14.** Mrs. Gay spent $225 for food last month. 40% of this was for meat. How much did she spend for meat last month?

**15.** Karen earns $75 a week. Her room is $18 a week. What per cent of her earnings is used for room rent?

**16.** Sue had 96 pages to read. She has read 36 pages. What per cent of the assignment has she read?

**17.** Charles pays $36 a week for room and board. This is 45% of his wages. How much are his wages?

**18.** Mary has read 24 pages. This is 60% of the assignment. How many pages in all are in the assignment?

▶ Think how to work each of the following problems. Estimate what a sensible answer is before you begin to figure on paper.

**19.** Dick puts 20% of what he earns in the bank. He put $4.50 in the bank last week. How much did he earn last week?

**20.** Len picks cherries for Mr. White. Mr. White allows Len to keep $33\frac{1}{3}\%$ of all the cherries he picks. Len picked 24 quarts in one day. How many could he keep for himself?

**21.** Mr. Gray paid $60 for paint. It cost $100 more to have the paint put on his home. The cost of the paint was what fraction of the total cost of painting the home? What decimal? What per cent?

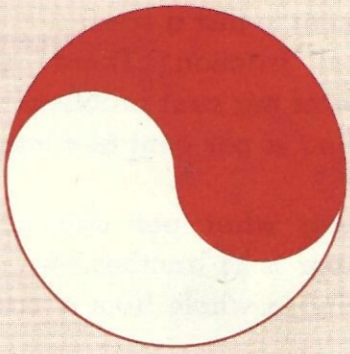
**22.** There are 21 boys in the seventh grade. This is 60% of the whole class. How many boys and girls are in the seventh grade?

**23.** Mr. Cobb raised 32 bushels of potatoes. He kept 12 bushels for his family, and sold the rest. What per cent of the potatoes did he keep for his family?

**24.** Mrs. Huff baked 75 cookies. She took 45 of them to a church bake sale. What per cent of the cookies did she take to the sale?

## Figures in Circles

1. Isabel drew the design at the right and gave directions for drawing it. Follow her directions and draw a design like hers.



1. Draw a circle.
2. Draw diameter and the midpoint of each half of diameter.
3. With the midpoints as centers and with radius equal to half the radius of the circle, draw semi-circles on opposite sides of the diameter.
4. Erase the diameter and the midpoints. Color each half of the circle.

2. Make designs like the ones below. Begin with circles having radii of 2 inches.

A.

B.

3. Can you write directions that others can understand and follow? Tell how to draw design A, above. Write each step clearly, briefly, and in order.

4. Write directions for design B.

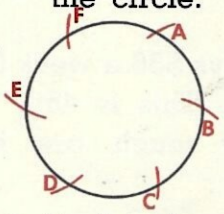
5. Many designs are based on a circle which has been divided into six equal arcs. Follow these directions for dividing a circle into six equal arcs. Point *A* can be anywhere on the circle.

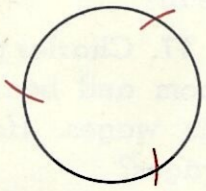
a. Draw a circle.

b. Set the sharp point of the compasses at *A*. With a radius equal to the radius of the circle, draw an arc which cuts the circle at *B*.

c. Set the sharp point of the compasses at *B*. With a radius equal to the radius of the circle, draw an arc which cuts the circle at *C*.

d. Continue completely around the circle.

A. 


B. 

6. Explain how to divide a circle into three equal arcs, as in circle B, above. Draw a circle and divide it into three equal arcs.

7. Draw a circle with a radius of 3 inches. Divide the circle into six equal arcs by the points *A*, *B*, *C*, *D*, *E*, and *F*.

Draw the lines *AC*, *CE*, and *EA*. What figure is formed in the circle?

Draw lines *BD*, *DF*, and *FB*. What figure is in the circle now?

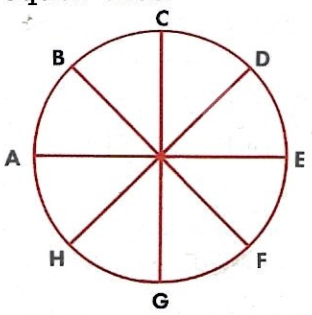
8. Draw a circle with a radius of 3 inches. Divide the circle into 6 equal arcs by the points *A*, *B*, *C*, *D*, *E*, and *F*.

Draw lines *AB*, *BC*, *CD*, *DE*, *EF*, and *FA*. What figure is in the circle?

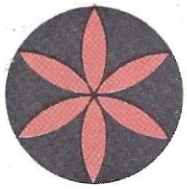
9. Color the designs you made in the problems above. They can be made into attractive posters.

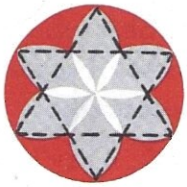
10. Many designs are based on a circle which has been divided into eight equal arcs. Follow these directions for dividing a circle into 8 equal arcs, as in the figure in the next column.

a. Draw a circle.
b. Draw any diameter *AE*.
c. Draw diameter *CG* perpendicular to *AE*.
d. Draw diameters *BF* and *HD* bisecting the angles made by *AE* and *CG*. The points *A* to *H* divide the circle into eight equal arcs.

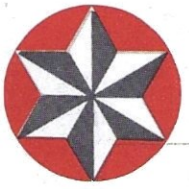


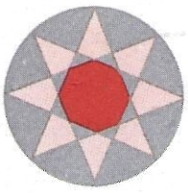

The designs at the bottom of the page are based on circles which have been divided into six or eight equal arcs. Copy and color the designs, beginning each with a circle with a radius of $3\frac{1}{2}$ inches. Invent other designs for circles divided into six or eight equal arcs.

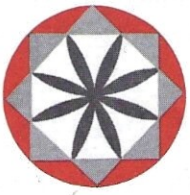
11. 

12. 

13.

14. 

15. 

16. 

## Patchwork Quilts

The great-grandmothers of many of us took great pride in the beautiful patchwork quilts they made. A patchwork quilt is made by sewing together pieces of cloth in patterns. There are hundreds of patterns, each with its own name and history. When you have completed these pages, you may wish to invent a new pattern and name it.

1. Before the War for Independence, George III, the English king, was ruler of America. The people of Virginia liked his wife, Charlotte. They named a county, a city, and a quilt pattern for her. When war came, Charlotte was no longer America's queen, and her quilt pattern was given a new name, Indian Meadows. Draw Indian Meadows in a square 5 inches on a side. Plan your work carefully.

2. A very old quilt pattern, known as the Variable Star, was renamed the Texas Star when many Americans began moving into Texas. It is simple to draw. Make the square $4\frac{1}{2}$ inches on a side.

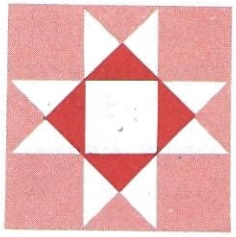
3. A quilt pattern, called Clay's Choice, was named for Henry Clay. Make the square 5 inches on a side. Figure into how many equal parts to divide each side.

4. Draw the Bow Knot in a square $4\frac{1}{2}$ in. on a side.

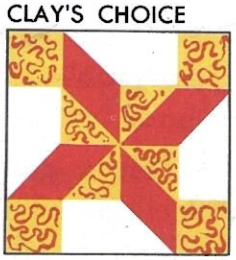
5. Draw the Necktie in a square $4\frac{1}{2}$ in. on a side.

INDIAN MEADOWS

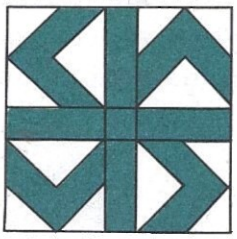
TEXAS STAR



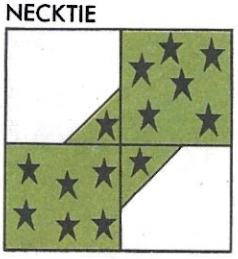
CLAY'S CHOICE



BOW KNOT



NECKTIE



## Designs in Use

1. When Fred's brother took a driver's license test, he received a booklet explaining the driving laws of his state. The booklet also pointed out that the shape of a traffic sign tells its meaning.

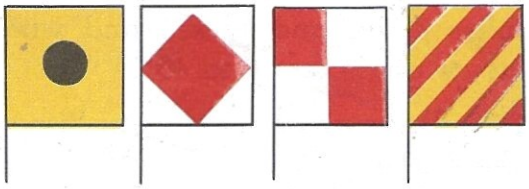
Study the signs above. Then match the shapes below with their meanings.

| SHAPES | MEANINGS |
|---|---|
| Circle | Railroad Ahead |
| Square | Stop |
| Rectangle | Slow Down |
| Octagon | Caution |
| Diamond | Speed Limit |

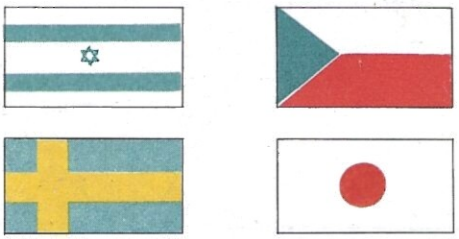
2. The figures below are the trademarks of several well-known companies. Can you identify them? Find as many trademarks and emblems as you can which use circles, squares, and other figures as part of their designs.

3. What figures are used in the designs above? Make poster-size copies of these or other trademark designs. Plan carefully and draw lines lightly so that they may be erased, if necessary.

4. Make copies of the International Code flags shown below. Try to find out what letters the flags stand for and how they are used. What shapes are there in these flags?



5. The flags of most nations have various figures in their designs. What figures can you find in the flags below? Try to find the countries from which they come. Make large copies of the flags.



## How Well Have You Learned?

*Use any tools you wish. Make neat drawings. Write the name of the figure under each.*

1. Draw an angle equal to 90° with sides about 2 in. long.

2. Draw an angle equal to 40° with sides about 2 in. long.

3. Draw an angle equal to 120° with sides about 2 in. long.

4. Draw a square with sides equal to $1\frac{3}{4}$ in.

5. Draw a rectangle $1\frac{1}{2}$ in. wide and $2\frac{1}{4}$ in. long.

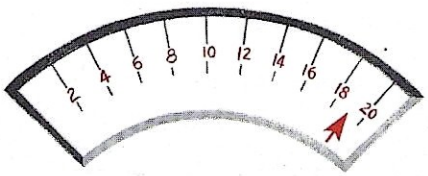
6. Draw a parallelogram with sides $2\frac{1}{4}$ in. and $1\frac{3}{4}$ in., and with acute angle equal to 40°.

7. Draw any acute angle. Bisect the angle.

8. Draw a right angle. Divide it into three equal angles.

9. Draw an obtuse angle. Bisect the angle.

10. Draw a circle with radius equal to $1\frac{1}{2}$ in. Divide the circle into six equal parts.




11. Draw a circle with radius $1\frac{1}{2}$ in. Draw a 6-pointed star within the circle.

*Write the missing numbers or words.*

12. A regular ☐ has six sides.

13. The angles of a square are all ☐ angles, and the sides are ☐.

14. An acute angle is ☐ than 90°.

15. Each angle of an ☐ triangle is equal to 60°.

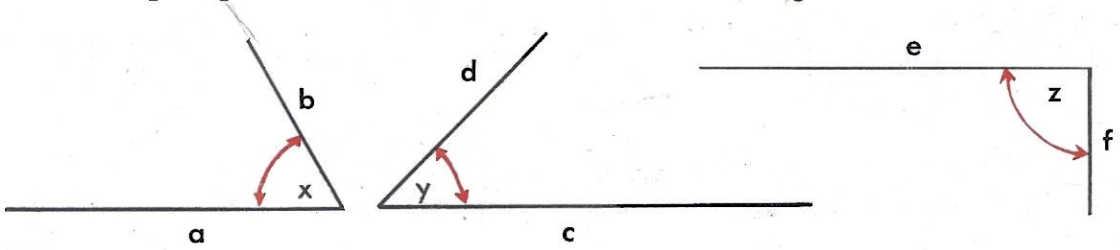
16. A regular pentagon has ☐ sides; all sides are ☐.

17. A triangle which has two sides equal is an ☐ triangle.

18. When two lines meet to form a right angle the lines are said to be ☐ to each other.

19. The sum of two angles is 180°. The angles are ☐.

20. Measure the lines and angles in the drawing below.



## Help Yourself to Improve

*Explain the terms below with words or drawings.*

1. These kinds of lines. (124)
   Horizontal  Vertical
   Parallel  Perpendicular

2. These kinds of angles. (124)
   Right  Straight
   Acute  Obtuse

3. These kinds of triangles. (125, 126, 128)
   Equilateral  Right
   Isosceles  Obtuse

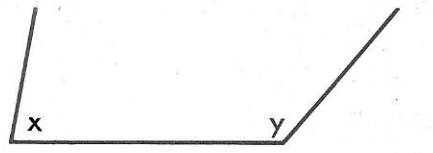
4. These 4-sided figures. (124, 125)
   Square  Parallelogram
   Rectangle  Trapezoid

5. These regular figures. (125, 129)
   Hexagon  Octagon
   Pentagon  Square

6. These parts of a circle. (130)
   Diameter  Circumference
   Radius  Arc

7. These tools for drawing. (125, 130, 131)
   Ruler  Protractor
   Compasses

8. Measure angles $x$ and $y$. (125)




9. Draw a line 3 in. long. Use compasses and a ruler to bisect it. (131)

10. Draw an obtuse angle. Use compasses and a ruler to bisect it. (131)

11. Draw any line AB. Mark a point C one inch above the middle part of AB. Use compasses and ruler to draw a line through C perpendicular to AB. (133)

12. Draw any acute angle. Use protractor and ruler to copy the angle. (125)

13. Draw a circle with radius one inch. Divide the circle into six equal parts. (138)

14. Draw an equilateral triangle with each side equal to $2\frac{1}{2}$ in. (126)

15. Draw an isosceles triangle with each side equal to 3 in. and with the angle between them equal to 40°. (126)

16. Draw two angles that are complementary. Make one of them 40°. How many degrees are in the other angle? (125)

17. Draw two angles that are supplementary. Make one of them 50°. How many degrees are in the other angle? (125)

## Show That You Know

*Use protractor and ruler to draw the following:*

1. An angle of 50°.
2. A right angle.
3. An angle of 115°.
4. A square with side $2\frac{1}{2}$ in.
5. An equilateral triangle with side 3 in.
6. A rectangle 3 in. long and 2 in. wide.
7. An isosceles triangle with the equal sides $2\frac{1}{2}$ in. and with the angle between the equal sides 50°.

*Write the missing words.*

8. The opposite sides of a rectangle are ▯ and ▯.
9. All the sides of a square are ▯ and all the angles are ▯.
10. The opposite sides of a parallelogram are ▯ and ▯.
11. The sum of two ▯ angles is 90°.
12. The sum of the angles of an equilateral triangle is ▯°.
13. The sum of two ▯ angles is 180°.

*Answer Yes or No.*

14. Is every equilateral triangle an isosceles triangle?
15. Is every isosceles triangle an equilateral triangle?
16. May a right triangle be isosceles?
17. May an equilateral triangle be a right triangle?
18. Is every equilateral triangle acute?

*Use compasses and ruler with these.*

19. Draw a circle with radius about $1\frac{1}{2}$ in. Divide the circle into 3 equal arcs. What is the figure formed by the lines that would join the points of division?
20. Draw a circle with radius about $1\frac{1}{2}$ in. Draw a diameter. Draw a second diameter perpendicular to the first one. Do the two diameters divide the circle into equal arcs? How many arcs? What is the figure formed by the lines that would join the points of division?
21. Copy the quilt patterns below. Make each drawing 4 in. square.

## Review Test I A

### PART I

Two of the three words in each group below belong together in some way. For example, in the first group, *annual* and *rate* belong together because both terms are used in interest problems.

*Choose the words in each group that belong together.*

1. Annual, degree, rate
2. Altitude, base, diameter
3. Arc, compasses, parallelogram
4. Interest, rectangle, annual
5. Principal, rate, vertical
6. Base, parallel, perpendicular
7. Acute angle, degree, radius
8. Triangle, equilateral, square
9. Angle, diameter, obtuse
10. Square, degree, angle

### PART II

*Choose the best answer.*

1. $\frac{5}{8} = (.58;\ .62\frac{1}{2};\ .06\frac{1}{4})$
2. $.4 = (4\%;\ \frac{4}{100};\ 40\%)$
3. $.83\frac{1}{3} = (\frac{2}{3};\ \frac{3}{4};\ \frac{5}{6})$
4. $6 \div \frac{1}{2} = (3;\ 9;\ 12)$
5. $6 \times 1\frac{1}{2} = (4;\ 9;\ 18)$
6. $6 \times \frac{2}{3} = (4;\ 9;\ 18)$
7. $4 \times .25 = (1;\ 10;\ 100)$
8. $10 \div 8 = (.12\frac{1}{2};\ 1\frac{1}{4};\ 12.5)$
9. $100 \times 2¢ = (20¢;\ \$2;\ \$20)$
10. $10¢ + \$\frac{1}{2} = (10\frac{1}{2}¢;\ \$10\frac{1}{2};\ \$\frac{3}{5})$

### PART III

*Find the answers.*

| | | |
|---|---|---|
| 1. | $10 \times 1.25$ | $6.25 \div 10$ |
| 2. | $1000 \times .12\frac{1}{2}$ | $100 \times 6.25$ |
| 3. | $\frac{2}{3} \times \frac{1}{2}$ | $675 \div 1000$ |
| 4. | $\frac{1}{2} + \frac{3}{8}$ | $\frac{1}{3} \times 1\frac{1}{2}$ |
| 5. | $\frac{2}{3} - \frac{1}{6}$ | $\frac{1}{2} + \frac{1}{6}$ |
| 6. | $\frac{5}{3} \div \frac{2}{3}$ | $\frac{1}{2} - \frac{1}{6}$ |
| 7. | $1.2 \div .2$ | $\frac{9}{4} \div \frac{3}{4}$ |
| 8. | $.4 \times .06$ | $3.2 \div 4$ |
| 9. | $4 \times 1\frac{1}{4}$ | $.2 \times 7.5$ |
| 10. | $.048 \div .02$ | $4 \times \$1.25$ |

### PART IV

*Write answers only.*

1. $18+6+6+6+6+6+6+6+6$
2. $26+6+5+9+3+7+8+4+2$
3. $71-7-7-7-7-7-7-7-7$
4. $52-3-8-2-7-5-6-2-4$
5. $6\frac{1}{4}+1\frac{1}{2}+\frac{1}{2}+\frac{3}{4}+1+3\frac{1}{2}+\frac{1}{4}+\frac{1}{2}$
6. $8\frac{1}{3}-\frac{2}{3}-\frac{2}{3}-\frac{2}{3}-\frac{2}{3}-\frac{2}{3}-\frac{2}{3}-\frac{2}{3}-\frac{2}{3}$
7. $3.2+.9+.9+.9+.9+.9+.9$
8. $8.1-.8-.8-.8-.8-.8-.8$

## Review Test I B

PART I. ADDITION

1. 783; 46; 1049; 84; 200
2. \$30; \$1.25; \$.90; \$17.50
3. $2\frac{1}{2}$; $6\frac{1}{4}$; $1\frac{7}{8}$; $2\frac{5}{8}$
4. $3\frac{1}{3}$; $1\frac{3}{4}$; $4\frac{1}{6}$
5. 1.25; 3.12; 17.50; 2.08
6. .125; 1.875; 16.250; .005
7. 1 ft. 9 in.; 3 ft. 6 in.

PART II. SUBTRACTION

1. $5103-1096$ $\$112.05-\$93.38$
2. $30-16\frac{3}{4}$ $6\frac{1}{4}-4\frac{5}{6}$
3. $18.730-5.697$ $6.000-.435$
4. Subtract 1 yd. 2 ft. from 6 yd.
5. Subtract 3 qt. from 1 gal. 1 qt.

PART III. MULTIPLICATION

1. $402\times840$ $360\times32\frac{1}{2}$
2. $17\frac{1}{4}\times384$ $6\frac{2}{3}\times4\frac{1}{2}$
3. $16.4\times.75$ $.144\times32.5$
4. Multiply 1 hr. 15 min. by 6.

PART IV. DIVISION

1. $14214\div46$ $\$60.80\div32$
2. $18\div2\frac{1}{4}$ $7\frac{1}{2}\div1\frac{1}{4}$
3. $.732\div.03$ $4.2\div.06$
4. Divide 8 ft. 4 in. by 5.
5. Divide 10 hr. 6 min. by 7.

PART V. COMPARING NUMBERS

*Write the numbers in each row in order of size, beginning with the largest.*

| | | | |
|---|---|---|---|
| 1. | $8\frac{3}{8}$ | 8.38 | VIII |
| 2. | .55 | $\frac{9}{16}$ | $\frac{8}{15}$ |
| 3. | .468 | .68 | .8 |
| 4. | $\frac{7}{8}$ | .9 | $\frac{5}{6}$ |

PART VI. ROUNDING NUMBERS

*Round to the nearest —*

| | | | |
|---|---|---|---|
| 1. | Hundred: | 739 | 854 |
| 2. | Thousand: | 8394 | 27630 |
| 3. | Tenth: | 4.375 | 1.625 |
| 4. | Hundredth: | .1728 | 5.636 |

PART VII. CHANGING FORMS

1. Write as per cents.
   .35 $\frac{3}{5}$ .04 $\frac{1}{4}$
2. Write as decimals.
   5% $\frac{8}{25}$ 22% $\frac{1}{8}$
3. Write as fractions in lowest terms.
   25% .4 $62\frac{1}{2}\%$ .48

PART VIII. PERCENTAGE EXAMPLES

1. $12\frac{1}{2}\%$ of $48=$ ☐ 18 is ☐% of 24
2. 12 is 25% of ☐ 6% of \$375 = ☐
3. 12 is ☐% of 40 45 is $7\frac{1}{2}\%$ of ☐

## Review Test I C

1. Last month Mr. Ford's speedometer read 17,984. Today it reads 20,021. How many miles has he driven?

2. Ben sells shoes. He earns \$2.25 a day plus 45¢ for each pair of shoes he sells. How much does he earn in a day when he sells 14 pairs of shoes?

3. A farmer had 600 baby chicks. He sold $37\frac{1}{2}\%$ of them. How many chicks did he sell?

4. George had 80¢ and spent 48¢ of it. What per cent of his money did he spend?

5. Bob sold 12 rabbits. This was $\frac{3}{4}$ of all he had. How many rabbits did Bob have before he sold any?

6. The regular price of a dress is \$18.75. The sale price is $33\frac{1}{3}\%$ less than the regular price. What is the sale price?

7. Find the interest on \$300 at 6% for 2 yr.

8. A salesman sells property for \$12,500. His rate of commission is $2\frac{1}{2}\%$. What is the amount of the commission?

9. What is the sale price if a 3% commission amounts to \$50?

10. The regular price of a suit was \$75. The sale price is \$60. What is the per cent of the discount?

11. There were 600 pupils in the Jackson School last year. There are 720 pupils this year. What is the per cent of the increase?

12. Find the interest on \$250 at 8% for 6 mo.

13. A grocer bought 8 bu. of potatoes at \$1.25 a bushel. He sold them for 45¢ a peck. What was his gain?

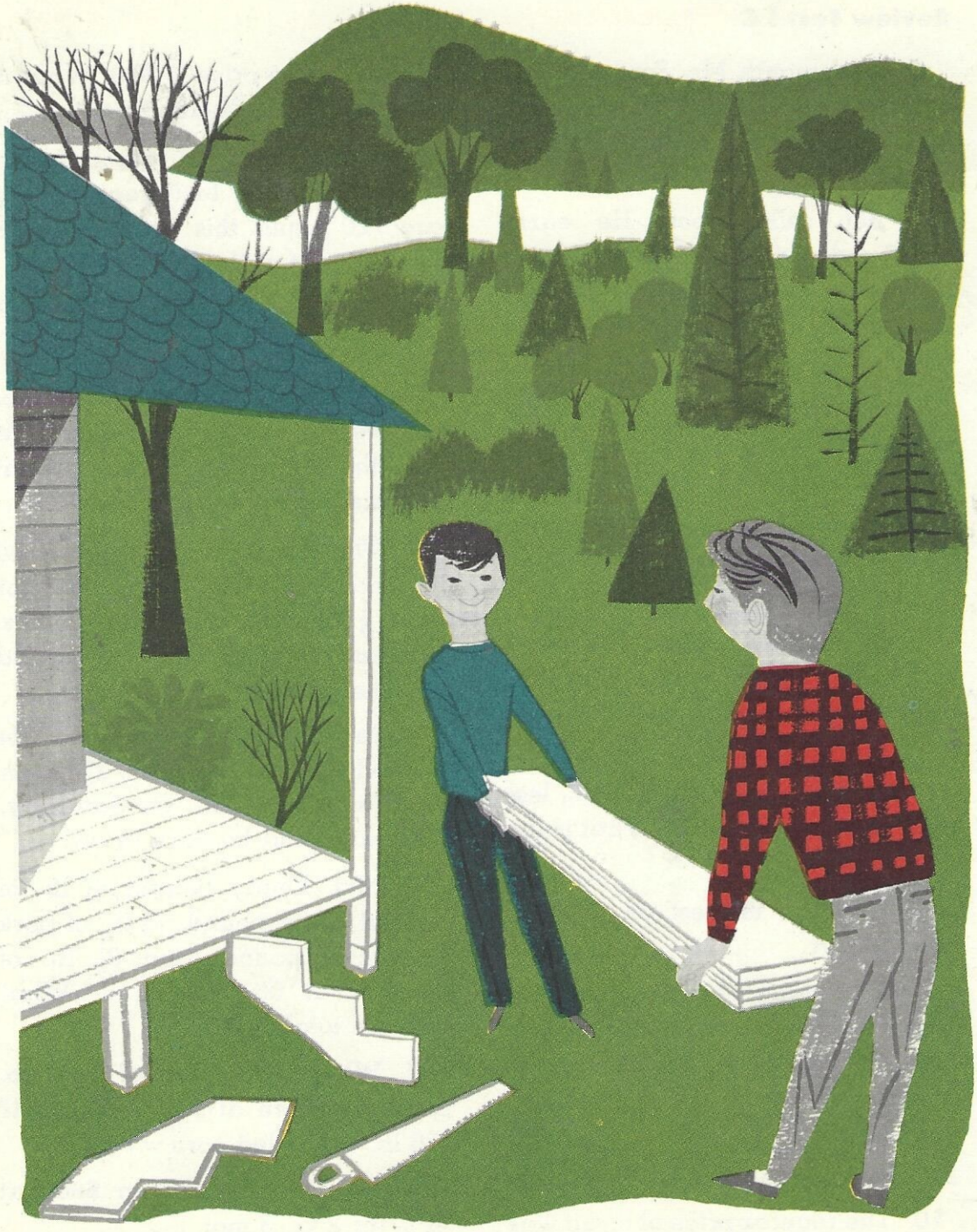
14. The Burns family spent \$360 last month. Of this, they spent $\frac{3}{8}$ for food, $\frac{1}{3}$ for rent, and $\frac{1}{6}$ for clothes. How many dollars did they spend for other things?

15. Jack earns 80¢ an hour. He worked $1\frac{1}{4}$ hr. on Monday, $2\frac{2}{3}$ hr. on Tuesday, and $4\frac{1}{2}$ hr. on Saturday. How much did he earn in all?

16. Mrs. Emory bought $6\frac{1}{4}$ lb. of beef at 72¢ a pound, $7\frac{3}{8}$ lb. of pork at 48¢ a pound, and $8\frac{1}{2}$ lb. of chicken at 56¢ a pound. What was the total cost?

17. What is the cost of 2800 lb. of shelled corn at \$1.35 a bushel? (56 lb. of shelled corn = 1 bu.)

18. Find the interest on \$600 at $4\frac{1}{2}\%$ for 2 yr. 3 mo.

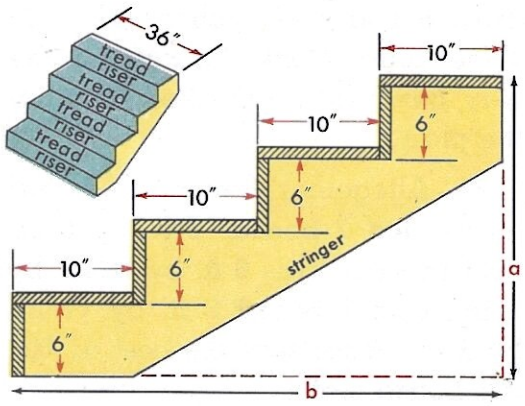


## Measuring Lumber

1. Ben helped his father build a summer cottage at a lake. The steps to the porch still needed to be completed. After measuring the distance from the ground to the floor, Ben's father said that they would need to draw a plan for the steps before beginning to build them. Why is a plan important?

2. The plan for the steps is shown below. How many treads will be needed for the steps? How many risers? How many stringers?

3. Treads and risers will be cut from 1-inch lumber. How many boards 6 feet long and 10 inches wide will be needed for the treads? How many treads will one 6-foot board make?




4. How many boards 6 feet long and 6 inches wide will be needed for the risers? How many risers will one of the 6-foot boards make?

5. When Ben's father drew the plan, he said that $\frac{1}{16}$ of an inch on his plan would stand for 1 inch on the actual steps. Measure distance $a$ on the drawing. The height of the completed steps will be [illegible] times as much as $a$. What will be the height of the completed steps?

6. Measure distance $b$ on the drawing. When the steps are built, distance $b$ will be [illegible] times as great as on the drawing. What will be the length of $b$ when the steps are completed?

7. Measure the whole length of the stringer in the drawing. What length board would be needed to

make two stringers? (6 ft., 8 ft., 10 ft.)

**8.** When Ben inquired about the price of the lumber needed, he was told that it would cost 15¢ per board foot. What did Ben need to know before he could figure the cost?

**9.** Ben learned that a board foot is a piece of lumber 1 foot long, 1 foot wide, and 1 inch thick. The lumberyard told him to use the formula below to find the number of board feet in a piece of lumber.

$$N = l \times w \times t$$

$N$ is the number of board feet, $l$ is the length in feet, $w$ is the width in feet, and $t$ is the thickness in inches.

To find the number of board feet in each riser, what would Ben have to do with the 6-inch width?

**10.** Find the number of board feet in each riser. In four risers.

**11.** Find the number of board feet in each tread. In four treads.

**12.** The lumberyard clerk told Ben that when the thickness of a board is a fraction of an inch or a mixed number, he should change it to the next higher whole number. Did this affect the lumber needed?

*Use the formula to find the number of board feet.*

**13.** 8 ft. by 1 ft. by 1 in.

**14.** 12 ft. by $\frac{3}{4}$ ft. by 1 in.

**15.** 10 ft. by $\frac{1}{2}$ ft. by $\frac{7}{8}$ in.

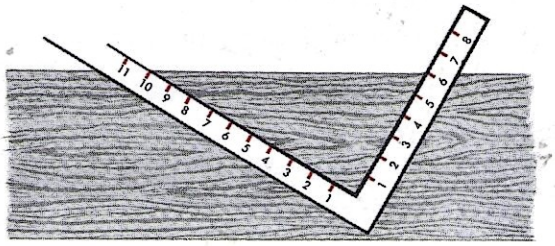
**16.** 8 ft. by 9 in. by 1 in.

**17.** 8 ft. by 9 in. by $\frac{3}{4}$ in.

**18.** 6 ft. by 6 in. by 2 in.

**19.** Find the cost of the boards in examples 13-18 at 14¢ per board foot.

**20.** The picture below shows how Ben held his carpenter's square to mark the stringers.



Using the scale, $\frac{1}{16}$ inch = 1 inch, draw a board 10 inches wide and 4 feet long. Mark the notches the way Ben's father marked them on the plan.

**21.** Altogether Ben figured that he needed 2 boards 6 ft. by 6 in. by 1 in., 2 boards 6 ft. by 10 in. by 1 in., and 1 board 8 ft. by 10 in. by 2 in. What was the cost at 15¢ per board foot?

## Mixed Practice

*Follow the signs. Be sure that your answer is in simplest form.*

| | | | | | |
|---|---|---|---|---|---|
| 1. | 2 ft. 3 in.<br>6 ft. 9 in.<br>+1 ft. 7 in. | $17\frac{1}{2}$ ft.<br>$82\frac{1}{3}$ ft.<br>+$43\frac{3}{4}$ ft. | $9\frac{3}{4}$ in.<br>$2\frac{5}{8}$ in.<br>+$4\frac{7}{16}$ in. | $18\frac{5}{6}$ yd.<br>$39\frac{3}{4}$ yd.<br>+$84\frac{2}{3}$ yd. | 2867<br>493<br>3082<br>97 |
| 2. | 8 ft. 4 in.<br>−1 ft. 9 in. | 7053 mi.<br>−1492 mi. | $18\frac{1}{4}$ ft.<br>−$6\frac{5}{8}$ ft. | 5 yd. 1 ft.<br>−2 yd. 2 ft. | 672<br>+5879 |
| 3. | 9 ft. 8 in.<br>×6 | $33\frac{3}{4}$ in.<br>×8 | 48 ft. 8 in.<br>×$6\frac{7}{8}$ | 207<br>×$23\frac{2}{3}$ | 7560<br>×809 |
| 4. | 9)20 ft. 3 in. | $18\frac{2}{3} \div 2$ | $38\frac{1}{4}$ in. ÷ 6 | $16\frac{1}{3} \div 3\frac{1}{2}$ | 17)5661 |

## Developing Power in Problem Solving

Work the problems on this page mentally. Use your pencil to write answers only.

1. Ann had 15 towels to hem. She has finished 9 of them. What per cent of her work is done?

2. Tom received $3 interest on his savings account. If this is 2% or $\frac{1}{50}$ of the amount he has in the bank, how much has he in the bank?

3. Jerry sold his bicycle for $16. If this was $\frac{2}{7}$ of what the bicycle cost, what did it cost?

4. Ellen has 144 sheets of paper. If 24 sheets are green, what fraction of her paper is green?

5. Jane bought $\frac{5}{8}$ yard of linen for $.95. At this rate, what is the cost of a yard of linen?

6. Mary used $2\frac{1}{2}$ pounds of sugar. If sugar costs 10¢ a pound, what did the sugar cost?

7. Tom played 18 games of table tennis. If he lost $\frac{1}{6}$ of the games, how many games did he win?

8. Mr. West bought 10 dozen oranges at $.50 a dozen and sold them at 3 for 20¢. What was his profit?

9. At 2 for 15¢, what is the cost of 50 pencils?

10. John paid 4% interest on $100. How much interest did he pay?

## Multiplying and Adding

1. For a Father's Day present, Marie and her mother bought 3 shirts at $4 each and a tie for $2. Marie figured, "3 × $4 + $2. $4 and $2 are $6 and 6 times 3 equals $18." What was wrong with Marie's figuring? What should she have done first? How much did they actually pay?

2. Study and explain:

$$7+8\times4=7+32=39$$
$$3\times6+9\times4=18+36=54$$

Notice that when an example calls for both addition and multiplication, *all the multiplication is done first.*

*Find the answers.*

3. $7 \times 2 + 4$ $\quad$ $6 \times 7 + 8 \times 8$
4. $5 + 7 \times 9$ $\quad$ $9 \times 9 + 6 \times 6$
5. $9 \times 5 + 8$ $\quad$ $4 \times 6 + 3 \times 9$

6. Two boys each received $4 for working one day and $6 for another. How much did they earn altogether?

THINK: 1 boy, $4 + $6, or $10
2 boys, 2 × $10, or ?

A problem like this may be written: $2(4+6)=?$

It is read, "2 times the sum of 4 + 6." The quantity within the parentheses must be found first. No sign between a number and the parentheses means multiplication.

7. Study and explain:

$$3(7+5)=3\times12=36$$
$$2(4+7)+3(8+5)=22+39=61$$

*Find the answers.*

8. $7(3+6)$ $\quad$ $2(3+4)+4(2+3)$
9. $8(5+3)$ $\quad$ $4(5+2)+3(4+1)$
10. $6(8+6)$ $\quad$ $6(3+5)+2(6+2)$

## Perimeters

1. Mr. Meyer wants to put a fence around his yard, which is a square measuring 45 feet on a side. How many feet of fencing will he need?

Mr. Meyer needs to find the *perimeter,* or the distance around, his yard. The distance around a square is four times the length of one side. Thus, if $p$ stands for perimeter and $s$ for the length of one side, we can use this formula to find the perimeter of a square:

$p = 4 \times s$ or $p = 4s$

2. Find the perimeter of a square

garden which is $208\frac{3}{4}$ ft. on a side.

3. Jack put weatherstripping on a window 36 inches wide and 54 inches high. How much weatherstripping was needed to go all the way around?

Jack had to find the perimeter of the window. If $p$ stands for perimeter and $l$ and $w$ stand for length and width, we can use this formula to find the perimeter of a rectangle:

$$p = 2 \times l + 2 \times w$$

When you use this formula, notice that there is both multiplication and addition in the same statement. What do you do first?

*Find the perimeters of these rectangles.*

4. length, $7\frac{1}{2}$ in.; width, $6\frac{1}{4}$ in.
5. length, 36 ft.; width, 24 ft.
6. length, $8\frac{3}{4}$ yd.; width, 5 yd.
7. length, 8.6 yd.; width, 3.4 yd.

8. Jack's garden measured 115 feet by 30 feet. When finding the perimeter, Jack decided that he could add the length and the width and multiply by 2, because there were 2 lengths and 2 widths. Was he right? Explain the formula he made. Find the perimeter.

$p = 2l + 2w$ or $p = 2(l + w)$

9. Use the formula to find the perimeter of a playground 400 feet wide and 580 feet long.

*Find the perimeters of these rectangles. Use the formula.*

10. length, 72 ft.; width, 70 ft.
11. length, $127\frac{1}{2}$ ft.; width, $84\frac{1}{4}$ ft.
12. length, $83\frac{1}{3}$ yd.; width, 25 yd.
13. length, $10\frac{1}{4}$ in.; width, $8\frac{3}{4}$ in.
14. length, 140 rd.; width, 67 rd.

15. Mr. James had a triangular garden whose sides were 50 ft., 70 ft., and 80 ft. He made the formula below to find the perimeter. Explain the formula and find the perimeter.

$$p = a + b + c$$

16. Use the formula to find the perimeter of a triangle whose sides are 7 in., 9 in., and 10 in.

17. Jim's yard is a rectangle 30 feet wide and 65 feet long. How many feet of fencing are needed to go along the two long sides and one end?

18. Each side of an equilateral triangle is 4 inches. Make a formula for finding the perimeter. What is the perimeter?

19. Find the perimeter of a rectangle 36 in. long and 2 ft. wide.

## Working with Formulas

1. Edith forgot to add salt when she baked a cake without following a recipe. If she had followed a recipe, she would not have forgotten an important part. Can you see that a formula is a sort of recipe? Explain.

2. Joel knew that the distance around (perimeter) a square field was 120 rods. In order to find the length of one side, he figured that he could change the formula from $p = 4s$ to $s = \frac{p}{4}$.

This is how he figured: "If I multiply one side by 4 to find the perimeter, then I must divide the perimeter by 4 to find the length of a side." Was his figuring correct? Use the formula to find a side.

3. Use the new formula, $s = \frac{p}{4}$. Find the length of one side *(s)* of a square when the perimeter *(p)* is 20 in.; 16 ft.; 15 yd.; 220 rd.

4. Peggy's father drove for 3 hours (time or *t*) at a rate *(r)* of 40 miles per hour. Peggy made the formula below to help her find the distance *(d)*. Was it correct? Explain. Find the distance traveled.

$d = r \times t$ or $d = rt$

5. Use the new formula to find *d* when *r* is 40 miles per hour and *t* is $2\frac{1}{2}$ hours; 3 hours; $3\frac{1}{4}$ hours.

6. The Gale family drove 315 miles *(d)* at an average rate *(r)* of 35 miles per hour. Sally made the formula below to find the time *(t)*. Was it correct? Explain. Find the time of the trip.

$t = d \div r$ or $t = \frac{d}{r}$

7. Use the above formula to find *t* when *r* is 36 miles per hour and *d* is 72 miles; 18 miles; 45 miles.

8. Mr. Dix drove 70 miles in 2 hours. What is his rate of speed? Make a formula to help you find the answer.

THINK: If $d = r \times t$, $r = \blacksquare \div \blacksquare$

9. Use your formula to find *r* when *d* is 200 miles and *t* is 5 hours.

10. In all the formulas you have used, on which side of the equal sign is the measure or part you wish to find? On which side of the equal sign are the measures or parts that you know?

■ **When making a formula, write the measure you wish to find on the left side of the equal sign, and write the measures which you know on the right side.**

## No Pencils, Please

This picture reminds you that you are to use your pencil to write answers only. Each set below will give you help with a certain kind of arithmetic exercise. Work as fast as you can, but work carefully.

### SET I

| | | | | | |
|---|---|---|---|---|---|
| 1. | $17+8$ | $33-6$ | $63\div 7$ | $4\times 18$ | $40-13$ |
| 2. | $18+19$ | $9\times 16$ | $144\div 8$ | $76\div 4$ | $3\times 409$ |
| 3. | $43+8$ | $38+9$ | $51-7$ | $34-8$ | $96\div 8$ |
| 4. | $7\times 27$ | $6\times 43$ | $136\div 4$ | $27+16$ | $60-28$ |

### SET II

| | | | | | |
|---|---|---|---|---|---|
| 1. | $\frac{1}{2}+\frac{1}{4}$ | $\frac{1}{3}+\frac{1}{6}$ | $\frac{2}{3}-\frac{1}{2}$ | $\frac{1}{2}-\frac{1}{6}$ | $6\div\frac{1}{2}$ |
| 2. | $6-\frac{2}{3}$ | $4\times\frac{3}{8}$ | $\frac{5}{6}\times 30$ | $\frac{1}{2}\times\frac{2}{3}$ | $\frac{1}{2}\times\frac{3}{4}$ |
| 3. | $\frac{2}{3}\div\frac{1}{2}$ | $\frac{3}{4}\div\frac{1}{2}$ | $\frac{3}{4}+\frac{1}{2}$ | $2\frac{1}{4}+\frac{3}{4}$ | $2\frac{1}{2}-\frac{3}{4}$ |
| 4. | $1\frac{1}{2}+\frac{3}{4}$ | $6\div\frac{3}{4}$ | $\frac{5}{8}\times\frac{4}{15}$ | $2\frac{1}{2}\div 2$ | $3\frac{1}{2}\times 4$ |

### SET III

| | | | | | |
|---|---|---|---|---|---|
| 1. | $.6\div 2$ | $.6\div .2$ | $.5\times 8$ | $.5\times .8$ | $.63\div .7$ |
| 2. | $.72\div 8$ | $7.5+.8$ | $8.1-.4$ | $.9+.6$ | $1.2-.7$ |
| 3. | $.2\times .25$ | $4\times .75$ | $3.2+1.8$ | $.76+.52$ | $4.3-2.3$ |
| 4. | $.6+3.9$ | $8.4\div .4$ | $8.4\div 4$ | $3.6\times 5$ | $3.6\times .5$ |

### SET IV

| | | | | | |
|---|---|---|---|---|---|
| 1. | $7\times 8+5$ | $8\times 5+6$ | $9\times 6+4$ | $7\times 9+3$ | $7\times 5+6$ |
| 2. | $4\times 6+2$ | $8\times 4+7$ | $9\times 4+6$ | $6\times 8+5$ | $8\times 9+5$ |
| 3. | $6+2\times 3$ | $4+7\times 2$ | $3+6\times 9$ | $10+8\times 5$ | $12+3\times 4$ |
| 4. | $2(3+1)$ | $5(6+3)$ | $10(2+8)$ | $6(4+5)$ | $9(3+2)$ |

### SET V

| | | | | |
|---|---|---|---|---|
| 1. | $12\frac{1}{2}\%$ of $40=$ ? | $12=$ ?$\%$ of 16 | $2=$ ?$\%$ of 6 | 32 is 50% of ? |
| 2. | $16\frac{2}{3}\%$ of $48=$ ? | $5=$ ?$\%$ of 20 | $8=$ ?$\%$ of 6 | 24 is 10% of ? |
| 3. | 25% of $360=$ ? | $3=$ ?$\%$ of 50 | 150% of $24=$ ? | 16 is 25% of ? |
| 4. | 6% of $200=$ ? | $9=$ ?$\%$ of 15 | 1% of $200=$ ? | 30 is 5% of ? |

## Areas of Rectangles

1. Roger and his father planned to put wood paneling on one wall of their recreation room. The wall was 14 feet long and 7 feet high. They chose paneling which came in squares 12 inches on a side.

To figure out how many squares were needed, Roger made a drawing of the wall, letting $\frac{1}{2}$ inch stand for 1 foot. When he marked off the squares and numbered them, he found that he would need 98 squares. Make a drawing to see whether Roger's figuring was correct. How many squares would there be in a row across the wall? How many rows of squares would there be from the floor to the ceiling?

2. Roger and his father planned to lay floor tile in a hallway outside the recreation room. The hallway was 6 feet long and $4\frac{1}{2}$ feet wide. Each tile was $\frac{3}{4}$ foot (9 inches) square. Make a drawing of the floor and mark off the squares. How many tiles were needed? How many squares were there in one row? How many rows were there?

3. Bill has a tablet which is 4 by 9 inches, and Fred has one which measures 5 by 7 inches. Which has more space on a sheet?

Make full-size drawings of both tablets. From heavy paper cut out a square one inch on a side. The amount of space, or area, that this square covers is one *square inch*. Lay the square on each drawing as often as it will fit and mark off the number of square inches in each. How many square inches are there in a row in Bill's tablet? In Fred's? How many rows are in Bill's tablet? In Fred's?

4. Bill made this rule for finding the area of a rectangle: "Count the number of square inches needed to cover the rectangle. A long way is to count one by one as the squares are numbered. A shorter way is to find the number of square inches in one row and multiply by the number of rows."

Explain Bill's rule. Is it correct?

5. If a rectangle is 6 inches long and 4 inches wide, how many square inches will there be in each row along the long side? How many rows will there be? Prove your answers with a drawing.

6. Explain the formula below. Use it to find the area of a rectangle 8 inches by 3 inches. Prove your answer with a drawing.

$A = l \times w$ or $A = lw$

*Use the formula to help you find the areas of these rectangles.*

7. length, 5 in.; width, 4 in.

8. length, 9 in.; width, 7 in.

9. Draw a rectangle $4\frac{1}{2}$ in. long and 3 in. wide. Mark as much of it as you can into squares 1 in. on a side.

Count the number of whole squares and part squares. What is the total number of square inches? Do you get the same answer when you use the formula?

10. Draw a rectangle $4\frac{1}{2}$ in. long and $2\frac{1}{2}$ in. wide. Mark as much of it as you can into squares 1 in. on a side.

Count the number of whole squares and part squares. What is the total number of square inches? Do you get the same number of square inches with the formula?

*Find the areas.*

11. $l = 6\frac{1}{4}$ in.; $w = 3$ in.

12. $l = 7\frac{1}{2}$ in.; $w = 4\frac{1}{2}$ in.

13. $l = 3\frac{3}{4}$ in.; $w = 2$ in.

14. $l = 9$ in.; $w = 2\frac{1}{4}$ in.

15. $l = 4\frac{3}{8}$ in.; $w = 3$ in.

16. Could you use Bill's rule (problem 4) to find the area of a room 20 feet long and 14 feet wide? What would have to be changed? Could you use the formula? Find the area of the room.

17. To find the area of a rectangle 1 ft. wide and 18 in. long, Roy multiplied length times width and came out with an answer of 18 square inches. Why was his answer wrong? What should he have done before multiplying?

■ **To find the area of a rectangle, multiply the length by the width. Be sure that both length and width are in the same unit of measure.**

18. How many square feet are there in a rug 9 feet by 12 feet?

19. A hall rug is 2 yd. by 6 yd. How many square yards is this?

20. A ranch is 2 miles wide and 6 miles long. How many square miles are there in the ranch?

## Areas of Squares

1. Can the formula for finding the area of a rectangle be used for finding the area of a square? Why? How is a square different from other rectangles?

2. Tom said that to find the area of a square you can just multiply the length of a side by itself. Was he right? Explain.

3. The formula below can be used to find the area of a square.

$A = s \times s$ or $A = s^2$

What does $s$ stand for? We use $s^2$ as a short way to write $s \times s$. We read $s^2$ as *s squared.* Can you think of any reason why, when we multiply a number by itself, we say that we square it?

4. When any number is multiplied by itself, a small $^2$ is written at the top and to the right of the number, as

$4 \times 4 = 4^2 = 16$

You read $4^2$ as *four squared.*

5. Read the following. Then find the value of each.

$6^2$ $9^2$ $8^2$ $20^2$ $30^2$

6. Use the formula to find the area of a square 12 ft. on a side.

7. Find the areas of squares whose sides have these lengths.

3 in. $5\frac{1}{2}$ ft. $3\frac{3}{4}$ ft. $8\frac{1}{3}$ yd.

8. Use wrapping paper to draw a square one foot on a side. Why is a square this size called a *square foot?*

Mark the large square into squares 1 inch on a side. What will each of the small squares be called?

How many square inches are there in each row of your drawing? How many rows are there? How many square inches are there in a square foot?

9. Draw a square yard on the blackboard. How long and how wide must it be? Mark the square into smaller squares 1 ft. on a side. What is each of the smaller squares?

How many square feet are there in each row of your drawing? How many rows are there? How many square feet are there in a square yard?

10. Find the number of square yards in one square rod.

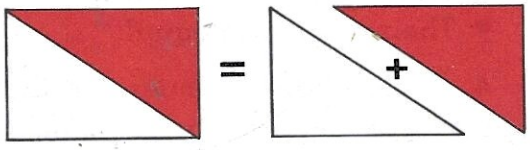
| SQUARE MEASURE |
| --- |
| 1 square inch (sq. in.) |
| 1 square foot (sq. ft.) = 144 sq. in. |
| 1 square yard (sq. yd.) = 9 sq. ft. |
| 1 square rod (sq. rd.) = $30\frac{1}{4}$ sq. yd. |

## Areas of Triangles

1. While working with cut-out squares to find the areas of squares and rectangles, Mark happened to fold a square along the diagonal. Noticing that the two halves were exactly the same size, he said, "The area of a square is twice as much as the area of a right triangle which has two sides the same length as the sides of the square."

Was Mark right? Cut out a square and fold it to prove your answer.

2. Draw and cut out a rectangle with base 6 in. and height 4 in. Cut it along a diagonal to form two triangles.

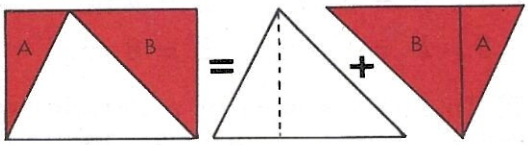


By placing one of the triangles on top of the other, show that they are equal. Explain these formulas.

$A$ (rectangle) $= b \times h$ or $A = bh$

$A$ (triangle) $= \frac{1}{2} \times b \times h$ or $A = \frac{1}{2}bh$

3. Draw and cut out a rectangle with base 6 inches and height 4 inches. Cut it and fit the pieces like this:




What is the area of the rectangle? Is the red triangle equal to the white triangle? What is the area of one of the triangles? Can you use the formula $A = \frac{1}{2}bh$ to help you find the area of this triangle?

*Find the area of each triangle below.*

4. $b = 6$ in.; $h = 5$ in.
5. $b = 7\frac{1}{2}$ ft.; $h = 6$ ft.
6. $b = 8$ in.; $h = 6\frac{1}{4}$ in.
7. $b = 16$ ft.; $h = 3\frac{3}{4}$ ft.

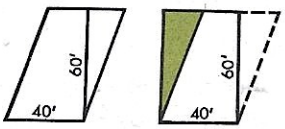
■ **To find the area of a triangle, multiply one half of the base by the height.**

8. Jerry and his dad planned to lay flagstones on their triangle-shaped patio. Jerry found that the base of the triangle was 25 feet and the height was 20 feet. How many square feet of space did they need to cover with flagstones?

## Areas of Parallelograms

1. In order to find out how much grass seed to buy to seed his back yard, Mr. Strauss needs to find the area of his yard. Because he lives in an odd-shaped block, the yard is shaped like a parallelogram. The parallelogram has a base of 40 feet and a height of 60 feet.

Study the figures below. Notice how a parallelogram can be changed to a rectangle. Why will the area of the rectangle be the same as the area of the parallelogram? Find the area of Mr. Strauss's yard.




2. Draw and cut out a rectangle and a parallelogram, each with a base of 7 inches and a height of 5 inches. (Remember that the height of a parallelogram is not a side, but the perpendicular distance between the parallel sides.)

Cut off one end of your parallelogram (the part that is in color in the drawing below) and fit it on the other end to form a rectangle. Is this rectangle the same size as the other rectangle? How many square inches are there in the rectangle? In the parallelogram?

3. Explain these statements about the rectangle and the parallelogram at the bottom of the first column.

- Their bases are equal.
- Their heights are equal.
- Their areas are equal.

4. Explain this formula for the area of a parallelogram. Could the same formula be used to find the area of a rectangle? Why?

$A = b \times h$ or $A = bh$

5. The base of a parallelogram is 30 yards. The height is 12 yards. What is the area?

*Find the area of each parallelogram below.*

6. $b = 7\frac{1}{2}$ ft.; $h = 6$ ft.
7. $b = 6\frac{1}{4}$ in.; $h = 4$ in.
8. $b = 5\frac{1}{2}$ yd.; $h = 8$ yd.

**To find the area of a parallelogram, multiply the base by the height.**

## Volume of Rectangular Solids

1. One evening Jane took care of a neighbor's baby. When it was the baby's bedtime, Jane helped the baby pack the toy blocks into the box, made of clear plastic. There were 5 blocks in each row and 4 rows on each layer. How many blocks fit in each layer? When all the blocks were in the box, there were 3 layers of blocks. How many blocks were there in all?

Explain why it was necessary to answer each of the following questions in order to find the total number of blocks in the box:

a. How many blocks in one row?
b. How many rows in a layer?
c. How many layers in all?

2. Frank's father has a wood shop. As a present for Frank's little brother, they sawed out enough small blocks, or *cubes*, to fill a box 4 inches wide, 6 inches long, and 3 inches deep. Each cube was 1 inch long, 1 inch wide, and 1 inch high. How many cubes did they have to cut to fill the box?

3. Each small cube in the box in problem 2 is 1 *cubic inch*. A cubic inch is a measure used to tell how much space, or *volume*, there is inside a solid like Frank's box of cubes. How many cubic inches are there in Frank's box?

4. A rectangle is a flat surface; it has only length and width. A box has length, width, and height. It is called a *rectangular solid*. Counting the top and bottom, how many *sides*, or *faces*, does a rectangular solid have? Is each side of a rectangular solid a rectangle? What kind of angle is each corner of a rectangular solid?

5. Find the volume in cubic inches of a rectangular solid 6 in. long, 7 in. wide, and 2 in. high.

THINK: How many cubic inches are there in one row? How many rows are there? How many layers?

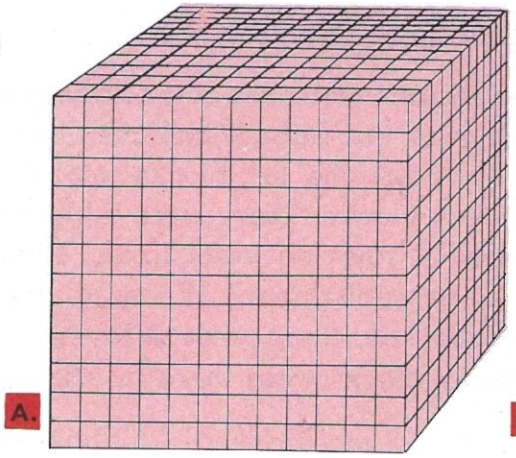
6. Explain the statement and the formula below.

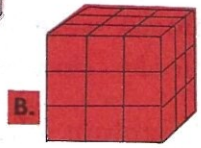
■ **The volume of a rectangular solid equals the length times the width times the height.**

$V = l \times w \times h$ $\quad V = lwh$

7. Find the volume of a rectangular solid 8 ft. by 6 ft. by 5 ft.

## Measurement Problems




1. Eddie went to a building supply store to buy 2 cubic feet of sand for his sister's sandbox. He had a box which measured 24 inches long, 14 inches wide, and 11 inches deep.

To find out whether the box would hold 2 cubic feet, Eddie used the formula, $V = lwh$, and found that the box contained 3696 cubic inches. Then he divided by 12 to find the number of cubic feet. He knew that his answer of 308 cubic feet was not a sensible answer. What was his mistake?

2. Use drawing *A*, above, to figure out how many cubic inches there are in a cubic foot. Then find out whether Eddie's box (problem 1) contained 2 cubic feet.

THINK: How many cu. in. are there in one row? How many rows are there in each layer? How many layers are there?

3. Use drawing B to help you figure out how many cubic feet there are in one cubic yard.

| CUBIC MEASURE |
| --- |
| 1 cubic inch (cu. in.) |
| 1 cubic foot (cu. ft.) = 1728 cu. in. |
| 1 cubic yard (cu. yd.) = 27 cu. ft. |

*Find the volumes of these rectangular solids.*

4. $l = 6$ in.; $w = 4$ in.; $h = 5$ in.
5. $l = 7\frac{1}{2}$ ft.; $w = 6$ ft.; $h = 3$ ft.
6. $l = 10$ ft.; $w = 8$ ft.; $h = 2\frac{1}{4}$ ft.

7. To find the volume of a rectangular solid 2 ft. wide, 1 yd. long, and 12 in. high, Jill multiplied $2 \times 1 \times 12$. What was her mistake? What should she have done before multiplying? Find the volume.

8. A legal bushel contains 2150.42 cu. in. How much more or

less than one cubic foot is this? About how many cubic feet are there in a bushel? Choose the best answer. (1 cu. ft.; $1\frac{1}{4}$ cu. ft.; $1\frac{1}{2}$ cu. ft.)

9. A rectangular box is 8 ft. × 6 ft. × 5 ft. Figuring 1 bushel as $1\frac{1}{4}$ cu. ft., how many bushels will the box hold?

10. The volume of a box is 40 cu. ft. Will it hold as many as 40 bu.? How many bushels will it hold?

11. A box holds 40 bushels. Is its volume as much as or more than 40 cubic feet? What is the volume of the box in cubic feet?

12. A legal gallon contains 231 cu. in. How many cubic inches are in one liquid quart? In one liquid pint?

THINK: ☐ qt. = 1 gal.
☐ pt. = 1 gal.

13. Frank has a can which measures 4 in. by 7 in. by 8 in. Will this can hold a gallon? How many cubic inches more or less than a gallon?

14. If one gallon equals 231 cu. in., about how many gallons are in one cubic foot? (6 gal.; $7\frac{1}{2}$ gal.; 8 gal.)

15. A rectangular tank is 8 ft. × 3 ft. × 2 ft. Figuring 1 cu. ft. as $7\frac{1}{2}$ gal., how many gallons will the tank hold? How many gallons more or less will it hold than a tank which is 4 ft. × $4\frac{1}{2}$ ft. × 3 ft.?

16. A rectangular pan is 22 in. × 14 in. × 6 in. Figuring 1 gal. as 231 cu. in., how many gallons will the pan hold?

17. Find the volume of a rectangular box 6 in. × 6 in. × 6 in. Will this box hold a gallon?

18. Find the volume of a rectangular box 6 in. × 6 in. × $6\frac{1}{2}$ in. Will this box hold a gallon?

19. Paul made a toy box that measured 14 in. by 24 in. by 12 in. What was the volume of the box?

How many square inches did he have to paint if he painted the outside surface of the box?

THINK: There are ☐ sides, or faces, on the box, including the top.

20. A box is 6 in. × 6 in. × 6 in. What is the area of one face? Of six faces? What is the volume?

21. Find the total area of the outside of a box 3 in. × 3 in. × 3 in.

22. The basement excavation for a new building was 48 ft. long, 48 ft. wide, and 12 ft. deep. How many cubic yards of dirt were removed?

How many truckloads of dirt were removed if 4 cu. yd. fill a truck?

## Comparing Circumference and Diameter

Workmen were painting lines on the street. While they were gone for lunch, someone rode a bicycle over the wet paint. The workmen thought that Jim had done it.

After looking at the paint marks, Jim said, "I can prove that I did not do it, because I have a 28-inch bike. Someone with a smaller bike must have ridden over the lines."

To prove that he had not run over the painted line, Jim measured the distance between the line and the first tire mark. He found it to be a little more than 75 inches. "My bike moves 88 inches every time the wheels go around," he said, "so I couldn't have done it."

1. The diameter of each wheel on Jim's bicycle was 28 inches. What was the circumference of each wheel? The circumference was ☐ times as great as the diameter.

THINK: 88 in. ÷ 28 in. = ☐

2. When you have a chance, use a 28-inch bike to see if Jim was correct when he said that his bicycle moved 88 in. each time the wheels went around. Begin with the valve stem at the bottom. Mark the beginning point and the point where the valve stem comes to the bottom again. Measure the distance between the two marks. Why will this be the circumference?

3. Use the same method to find the circumference of the wheels on 24-in. and 26-in. bicycles. Divide each circumference by diameter.

Are your answers about the same as your answer in problem 1?

4. How large was the bicycle that ran over the painted line in the picture?

*Divide circumference by diameter in the following:*

5. $c = 66$ in.; $d = 21$ in.
6. $c = 49\frac{1}{2}$ in.; $d = 15\frac{3}{4}$ in.
7. $c = 8\frac{1}{4}$ in.; $d = 2\frac{5}{8}$ in.

8. Change the figures in example 7 to decimals and divide. Find each answer to the nearest hundredth.

**In all circles the circumference divided by the diameter is equal to about 3.1416. This may be rounded to 3.14 or $3\frac{1}{7}$.**

Circumference divided by diameter is the same for all circles. This comparison, or *ratio*, is called *pi*. Pi is a Greek letter written as $\pi$.

9. Explain the formulas below.

$c \div d = \pi$ or $\pi = \frac{c}{d}$

$c = \pi \times d$ or $c = \pi d$

$d = c \div \pi$ or $d = \frac{c}{\pi}$

10. Which formula would you use to find the circumference of a circle with a diameter of 14 inches? Find $c$ twice, once using $\pi = 3\frac{1}{7}$, and then using $\pi = 3.14$.

11. Which formula would you use to find the diameter of a circle whose circumference is 242 feet? Find $d$ twice, once using $\pi = 3\frac{1}{7}$, and then using $\pi = 3.14$.

The ratio $3\frac{1}{7}$ is not exactly equal to 3.14, and neither one is exactly equal to pi. This means that the answers you get from using them are not exactly the same. However, either 3.14 or $3\frac{1}{7}$ is close enough to pi for all practical purposes.

Use $\pi = 3\frac{1}{7}$ to work the following. Check with $\pi = 3.14$.

*Find c when d is —*

| | | | |
|---|---|---|---|
| 12. | 21 in. | 49 in. | 56 yd. |
| 13. | $3\frac{1}{2}$ ft. | 140 rd. | $2\frac{1}{3}$ mi. |
| 14. | $10\frac{1}{2}$ ft. | $5\frac{1}{4}$ in. | $9\frac{1}{3}$ yd. |

*Find d when c is —*

| | | | |
|---|---|---|---|
| 15. | 88 ft. | 220 yd. | 121″ |
| 16. | 440 yd. | 187 ft. | 132″ |
| 17. | 4.4 mi. | $5\frac{1}{2}$ mi. | $8\frac{1}{4}$″ |

18. Explain this formula. Remember that radius is equal to $\frac{1}{2}$ of diameter.

$c = \pi \times 2r$ or $c = 2\pi r$

*Find c when r is —*

| | | | | |
|---|---|---|---|---|
| 19. | $3\frac{1}{2}$″ | $1\frac{3}{4}$″ | $10\frac{1}{2}'$ | 15″ |
| 20. | $12\frac{1}{4}$″ | $4\frac{2}{3}'$ | $8\frac{3}{4}'$ | 4″ |
| 21. | 3′ | 5″ | 10′ | 8′ |

## Practice with Per Cents

*Finding missing numbers.*

| | | | |
|---|---|---|---|
| 1. | $\frac{1}{4}=.25=$ ☐% | $\frac{1}{2}=.5=$ ☐% | $\frac{1}{5}=.2=$ ☐% |
| 2. | ☐$=.75=$ ☐% | ☐$=.40=$ ☐% | ☐$=.80=$ ☐% |
| 3. | ☐$=$ ☐$=60\%$ | ☐$=$ ☐$=90\%$ | $\frac{1}{3}=$ ☐$=$ ☐% |
| 4. | ☐$=$ ☐$=12\frac{1}{2}\%$ | ☐$=$ ☐$=16\frac{2}{3}\%$ | ☐$=.66\frac{2}{3}=$ ☐% |
| 5. | $\frac{7}{8}=$ ☐$=$ ☐% | ☐$=.37\frac{1}{2}=$ ☐% | ☐$=$ ☐$=10\%$ |
| 6. | $1\frac{1}{2}=$ ☐$=$ ☐% | ☐$=1.2=$ ☐% | ☐$=.83\frac{1}{3}=$ ☐% |

*Finding per cents.*

| | | | |
|---|---|---|---|
| 7. | $5\%$ of $800=$ ☐ | $6\frac{1}{4}\%$ of $320=$ ☐ | $16\frac{2}{3}\%$ of $540=$ ☐ |
| 8. | $4\frac{1}{2}\%$ of $600=$ ☐ | $57\%$ of $4000=$ ☐ | $5\%$ of $4000=$ ☐ |
| 9. | $6\%$ of $250=$ ☐ | $8\frac{1}{3}\%$ of $2988=$ ☐ | $.5\%$ of $4000=$ ☐ |
| 10. | $7\frac{1}{2}\%$ of $400=$ ☐ | $\frac{1}{2}\%$ of $360=$ ☐ | $300\%$ of $288=$ ☐ |
| 11. | $1\%$ of $3600=$ ☐ | $100\%$ of $6283=$ ☐ | $99\%$ of $750=$ ☐ |
| 12. | $5\%$ of $7840=$ ☐ | $125\%$ of $72=$ ☐ | $700\%$ of $3472=$ ☐ |

*Finding what per cent one number is of another number.*

| | | | |
|---|---|---|---|
| 13. | 16 is ☐% of 400 | 5 is ☐% of 75 | 14 is ☐% of 28 |
| 14. | 83 is ☐% of 83 | 10 is ☐% of 5 | 5 is ☐% of 45 |
| 15. | 3 is ☐% of 180 | 180 is ☐% of 200 | 100 is ☐% of 750 |

*Finding a whole number when you know a part of it.*

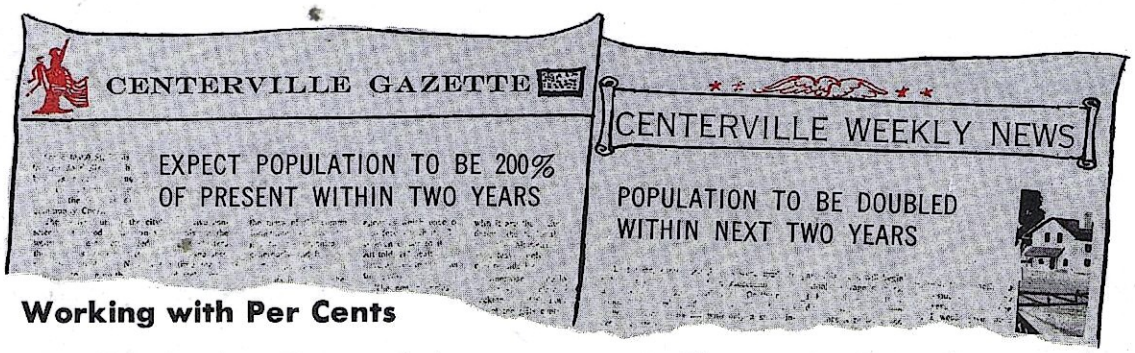
| | | | |
|---|---|---|---|
| 16. | 25 is $50\%$ of ☐ | 80 is $20\%$ of ☐ | 25 is $2\frac{1}{2}\%$ of ☐ |
| 17. | 180 is $30\%$ of ☐ | 75 is $100\%$ of ☐ | 15 is $1.5\%$ of ☐ |

*Finding missing numbers.*

| | | | |
|---|---|---|---|
| 18. | $4\%$ of $\$250=$ ☐ | $116\%$ of $\$750=$ ☐ | $22\%$ of ☐ $=\$33$ |
| 19. | ☐% of $\$200=\$100$ | ☐% of $\$200=\$50$ | $150\%$ of ☐ $=\$12$ |

**20.** Mr. Smith borrowed $500 at $4\frac{1}{2}\%$ interest. How much interest did he have to pay if he kept the money 1 year? Two years? Six months?

**21.** Mr. Jacobs paid $18 interest on a loan for one year. If the interest rate was 3%, how much had he borrowed?


CENTERVILLE GAZETTE
EXPECT POPULATION TO BE 200% OF PRESENT WITHIN TWO YEARS
CENTERVILLE WEEKLY NEWS
POPULATION TO BE DOUBLED WITHIN NEXT TWO YEARS

## Working with Per Cents

1. Do the headlines of the two Centerville papers mean the same thing? Why? If Centerville's population is now 3500, what will it be two years from now according to the *Gazette?* What will it be according to the *Weekly News?*

2. A new jet plane factory is expected to employ 1000 workers. To the nearest whole per cent, what per cent would this be of the present population of Centerville? What per cent would this be of the expected population?

3. Of the total present population of Centerville, 24.2% are children under 14 years of age. How many of the 3500 people are children under 14?

4. How many pupils are there now in the seventh grade of Centerville School if 1.6% of the present population is in the seventh grade?

5. There are 70 children in the kindergarten at Centerville School. What per cent is this of the total present population of Centerville?

6. There are 45 students in the eighth grade at Centerville School. If this is 9% of all the pupils in the school, how many pupils are there in the school?

THINK: 9% of the pupils = 45
1% of the pupils = ?
100% of the pupils = ?

7. Roger read that the value of the products of North Dakota was about $800,000,000 in a certain year. Farm products made up 95% of the total. What was the value of farm products?

8. The value of mineral products produced in North Dakota in the same year amounted to $8,000,000. What per cent was this of the $800,000,000 value of all products?

9. According to the United States census, 64% of the population lives in city areas. The population of the United States was about 165,000,000 persons in a certain year. How many persons lived in city areas? How many persons did not live in cities?

## Work with Fractions and Mixed Numbers

*Change to lowest terms.*

1. $\frac{2}{16}$ $\frac{9}{12}$ $\frac{3}{6}$ $\frac{5}{10}$
2. $\frac{15}{18}$ $\frac{28}{32}$ $\frac{6}{8}$ $\frac{8}{12}$
3. $\frac{4}{12}$ $\frac{2}{6}$ $\frac{3}{18}$ $\frac{24}{45}$

4. To change an improper fraction like $\frac{12}{8}$ to simplest form, the improper fraction must be changed to a whole number or a mixed number, and the fraction part of the mixed number must be in lowest terms. Explain how this is done.

*Change to simplest form.*

5. $\frac{10}{8}$ $\frac{8}{3}$ $\frac{14}{8}$ $\frac{18}{4}$
6. $\frac{15}{12}$ $\frac{15}{8}$ $\frac{15}{4}$ $\frac{15}{6}$
7. $\frac{8}{6}$ $\frac{20}{8}$ $\frac{16}{6}$ $\frac{42}{24}$
8. $\frac{9}{4}$ $\frac{9}{3}$ $\frac{25}{4}$ $\frac{72}{48}$

*Change to equivalent fractions with the denominators indicated.*

9. $\frac{2}{3}=\frac{?}{12}$ $\frac{1}{4}=\frac{?}{8}$ $\frac{5}{6}=\frac{?}{12}$
10. $\frac{1}{2}=\frac{?}{12}$ $\frac{1}{2}=\frac{?}{4}$ $\frac{1}{4}=\frac{?}{12}$
11. $\frac{1}{3}=\frac{?}{12}$ $\frac{1}{6}=\frac{?}{12}$ $\frac{1}{2}=\frac{?}{8}$
12. $\frac{3}{5}=\frac{?}{45}$ $\frac{7}{8}=\frac{?}{32}$ $\frac{9}{10}=\frac{?}{90}$
13. $\frac{3}{4}=\frac{?}{8}$ $\frac{3}{4}=\frac{?}{12}$ $\frac{1}{2}=\frac{?}{6}$
14. $\frac{1}{3}=\frac{?}{6}$ $\frac{2}{3}=\frac{?}{6}$ $\frac{3}{4}=\frac{?}{16}$
15. $\frac{2}{3}=\frac{?}{15}$ $\frac{2}{3}=\frac{?}{24}$ $\frac{2}{3}=\frac{?}{36}$
16. $\frac{2}{3}=\frac{?}{48}$ $\frac{3}{4}=\frac{?}{36}$ $\frac{5}{8}=\frac{?}{40}$

*Add. Find each sum in simplest form.*

17. $\frac{1}{5}$ $\frac{1}{3}$ $2\frac{3}{8}$ $4\frac{3}{6}$
$\underline{\frac{2}{5}}$ $\underline{\frac{2}{3}}$ $\underline{3\frac{2}{8}}$ $\underline{2\frac{1}{6}}$
18. $\frac{3}{4}$ $\frac{1}{4}$ $4\frac{5}{8}$ $8\frac{1}{3}$
$\underline{\frac{1}{3}}$ $\underline{\frac{5}{6}}$ $\underline{1\frac{2}{3}}$ $\underline{6\frac{1}{4}}$
19. $\frac{1}{4}$ $\frac{1}{2}$ $1\frac{5}{12}$ $6\frac{2}{3}$
$\underline{\frac{3}{8}}$ $\underline{\frac{1}{6}}$ $\underline{3\frac{1}{3}}$ $\underline{1\frac{5}{6}}$
20. $\frac{1}{2}$ $\frac{1}{4}$ $1\frac{2}{3}$ $8\frac{1}{3}$
$\frac{5}{8}$ $\frac{1}{6}$ $2\frac{1}{2}$ $2\frac{3}{4}$
$\underline{\frac{3}{4}}$ $\underline{\frac{3}{8}}$ $\underline{1\frac{5}{6}}$ $\underline{7\frac{1}{2}}$

21. Explain the borrowing in the example below. Copy and complete the work.

$$8\tfrac{1}{3} = 7 + 1\tfrac{1}{3} = 7\tfrac{4}{3}$$
$$\underline{-1\tfrac{2}{3}} \qquad\qquad \underline{1\tfrac{2}{3}}$$

*Do the steps needed to prove the following.*

22. $2\frac{1}{4}=1\frac{5}{4}$ $4\frac{7}{8}=3\frac{15}{8}$ $6\frac{1}{4}=5\frac{10}{8}$
23. $8\frac{1}{3}=7\frac{8}{6}$ $6\frac{2}{3}=5\frac{5}{3}$ $7\frac{1}{2}=6\frac{9}{6}$

*Subtract. Find each answer in simplest form.*

24. $6\frac{1}{4}$ $8\frac{1}{6}$ $5\frac{3}{8}$ $7\frac{5}{12}$
$\underline{1\frac{3}{4}}$ $\underline{2\frac{5}{6}}$ $\underline{3\frac{5}{8}}$ $\underline{3\frac{7}{12}}$
25. $5\frac{1}{8}$ $7\frac{5}{12}$ $6\frac{1}{5}$ $4\frac{1}{2}$
$\underline{1\frac{1}{2}}$ $\underline{2\frac{2}{3}}$ $\underline{3\frac{1}{2}}$ $\underline{1\frac{2}{3}}$

**26.** Explain why, when multiplying with small mixed numbers, it is usually best to change them to improper fractions, as in the example below.

$2\frac{2}{3} \times 2\frac{1}{4} = ?$

$(2\frac{2}{3} = \frac{8}{3};\ 2\frac{1}{4} = \frac{9}{4})$

$\overset{2}{\cancel{8}}_{\cancel{3}_1} \times \overset{3}{\cancel{9}}_{\cancel{4}_1} = ?$

*Multiply. Find each product in simplest form.*

| | | | |
|---|---|---|---|
| **27.** | $2\frac{1}{2} \times 2\frac{2}{3}$ | $8\frac{2}{3} \times 1\frac{7}{8}$ | $6\frac{1}{4} \times 5\frac{1}{3}$ |
| **28.** | $1\frac{7}{8} \times 2\frac{1}{2}$ | $1\frac{2}{3} \times 7\frac{1}{2}$ | $4\frac{4}{5} \times 1\frac{7}{8}$ |
| **29.** | $13 \times 2\frac{1}{8}$ | $8\frac{1}{3} \times 2\frac{2}{5}$ | $18 \times 8\frac{1}{3}$ |
| **30.** | $12 \times 2\frac{2}{3}$ | $1\frac{5}{8} \times 12$ | $3\frac{3}{4} \times 16$ |

**31.** Explain why, when multiplying larger mixed numbers and whole numbers, it is usually best not to change the mixed numbers to improper fractions, as below.

**A.**

$$\begin{array}{r} 426\frac{2}{3} \\ \times\ 24 \\ \hline 16 = 24 \times \frac{2}{3} \\ 1704 = 4 \times 426 \\ 8520 = 20 \times 426 \\ \hline 10240 \end{array}$$

**B.**

$$\begin{array}{r} 268 \\ \times\ 37\frac{1}{2} \\ \hline 134 = \frac{1}{2} \times 268 \\ 1876 = 7 \times 268 \\ 8040 = 30 \times 268 \\ \hline 10050 \end{array}$$

*Multiply. Find each product in simplest form.*

| | | | | |
|---|---|---|---|---|
| **32.** | $17\frac{3}{4}$ | 56 | $492\frac{2}{3}$ | 724 |
| | 32 | $23\frac{7}{8}$ | 42 | $52\frac{1}{4}$ |
| **33.** | 60 | 96 | 480 | $627\frac{1}{3}$ |
| | $28\frac{3}{4}$ | $40\frac{5}{6}$ | $64\frac{5}{8}$ | 84 |

**34.** What is the rule for dividing by a fraction? Explain:

$7\frac{1}{2} \div \frac{3}{4} = \frac{15}{2} \div \frac{3}{4} = \overset{5}{\cancel{15}}_{\cancel{2}_1} \times \overset{2}{\cancel{4}}_{\cancel{3}_1} = 10$

CHECK: $10 \times \frac{3}{4} = 7\frac{1}{2}$

*Divide. Find each quotient in simplest form. Check.*

| | | | |
|---|---|---|---|
| **35.** | $\frac{7}{8} \div \frac{1}{2}$ | $\frac{5}{6} \div \frac{2}{3}$ | $2\frac{1}{4} \div \frac{3}{4}$ |
| **36.** | $\frac{2}{3} \div \frac{1}{6}$ | $\frac{3}{4} \div \frac{1}{3}$ | $6\frac{1}{4} \div \frac{5}{8}$ |
| **37.** | $6 \div \frac{1}{4}$ | $6 \div \frac{3}{4}$ | $7\frac{1}{2} \div \frac{3}{8}$ |
| **38.** | $7\frac{1}{2} \div 1\frac{1}{2}$ | $6\frac{1}{4} \div 2\frac{1}{4}$ | $2\frac{1}{2} \div 5$ |

*Follow the signs. Find each answer in simplest form.*

| | | | |
|---|---|---|---|
| **39.** | $1\frac{1}{2} - 1\frac{3}{8}$ | $5\frac{2}{3} \div \frac{5}{6}$ | $1\frac{1}{3} + 2\frac{1}{2}$ |
| **40.** | $1\frac{7}{8} \times 2\frac{1}{2}$ | $3\frac{1}{4} + 1\frac{7}{8}$ | $5\frac{2}{5} - 1\frac{3}{4}$ |
| **41.** | $3\frac{3}{5} \div 2\frac{1}{4}$ | $5\frac{1}{2} \div 3\frac{1}{6}$ | $3\frac{1}{2} \times 1\frac{1}{16}$ |
| **42.** | $1\frac{15}{16} \times 336$ | $2\frac{1}{4} - 1\frac{2}{3}$ | $2\frac{2}{3} + 1\frac{1}{4}$ |
| **43.** | $8\frac{1}{6} + 1\frac{2}{3}$ | $1\frac{3}{4} \div 1\frac{1}{6}$ | $3\frac{1}{3} \times 3\frac{1}{3}$ |
| **44.** | $4\frac{1}{3} - 1\frac{2}{3}$ | $4\frac{7}{8} \div 9\frac{3}{4}$ | $2\frac{1}{4} \times 1\frac{5}{6}$ |
| **45.** | $420 \times 15\frac{1}{6}$ | $7\frac{7}{8} + 2\frac{1}{3}$ | $4\frac{1}{8} - 1\frac{5}{8}$ |
| **46.** | $1\frac{7}{8} - 1\frac{3}{4}$ | $6\frac{1}{3} \div 2\frac{3}{8}$ | $1\frac{4}{5} + 2\frac{1}{6}$ |

## How Well Have You Learned?

*Find the perimeter of —*

1. A rectangle 11 in. long and $8\frac{1}{2}$ in. wide.

2. A rectangle 1.5 ft. long and .9 ft. wide.

3. A square with each side $2\frac{1}{2}$ rods.

4. A triangle with sides 8 in., 15 in., and 17 in.

5. An equilateral triangle with each side 3.2 ft.

*Find the circumference of —*

6. A circle with radius 5 in. (Use $\pi = 3.14$)

7. A circle with diameter $31\frac{1}{2}$ in. (Use $\pi = 3\frac{1}{7}$)

*Find the area of —*

8. A rectangle: $l = 8'$; $w = 3\frac{3}{4}'$

9. A square: sides $4\frac{1}{2}$ in.

10. A triangle: $b = 5''$; $h = 8''$

11. A parallelogram: $b = 9''$; $h = 5''$

*Find the volume of —*

12. A rectangular solid: $l = 7\frac{1}{2}'$; $w = 4'$; $h = 2\frac{1}{2}'$

13. A cube: each side $= 2\frac{1}{2}$ in.

14. How many board feet are in a piece of lumber 12 ft. long, 10 in. wide, and 2 in. thick?

15. At 15¢ a board foot, what is

the cost of a piece of lumber 16 ft. long, 9 in. wide, and 1 in. thick?

16. How many square tiles with each side 12 in. are needed to cover one sq. yd.?

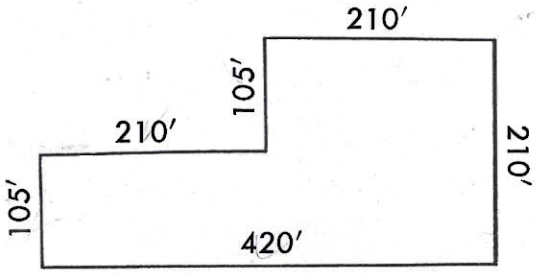
17. How many square tiles with each side 9 in. are needed to cover 1 sq. yd.?

18. A train travels at an average rate of 50 miles per hour. At this rate, how many miles will it travel in $2\frac{1}{2}$ hr.?

19. A rectangular tank is 33 in. long, 15 in. wide, and 14 in. deep. How many gallons does it hold?

20. A rectangular box is 6 ft. x $3\frac{3}{4}$ ft. x 3 ft. How many bushels does it hold?

21. A field has the shape and dimensions shown in the drawing below. Find the distance around the field.



## Help Yourself to Improve

*Tell how you would find each of the following:*

1. The number of board feet in a piece of lumber. (150)

2. The perimeter of a square; a rectangle; a triangle. (152, 153)

3. The area of a rectangle; of a square. (156, 157, 158)

4. The area of a triangle. (159)

5. The area of a parallelogram. (160)

6. The volume of a rectangular solid; of a cube. (161)

7. The circumference of a circle when the diameter is given; when the radius is given. (165)

8. The diameter of a circle when the circumference is given. (165)

9. How many board feet are in a piece of lumber 12 ft. long, 9 in. wide, and 1 in. thick. (150)

10. A yard is a square with each side 27 ft. Fence for the yard costs $22\frac{1}{2}$¢ per foot. What is the cost of enough fence to go all the way around the yard? (153)

11. A dresser scarf (rectangle) is 32 in. long and 12 in. wide. What is the length of the hem all the way around the scarf? (153)

12. A floor is 12 ft. long and $10\frac{1}{2}$ ft. wide. What is the area of the floor in square feet? In square yards? (157)

13. A rectangle is $4\frac{1}{2}$ ft. by $2\frac{1}{2}$ ft. It is covered with squares of cardboard. The side of each square is 6 in. How many squares are there in all? (157)

14. A rectangular solid is 8 ft. $\times$ $3\frac{3}{4}$ ft. $\times$ $2\frac{1}{2}$ ft. Find the volume in cu. ft. In cu. yd. (161)

15. A rectangular tank is $16\frac{1}{2}$ in. $\times$ $10\frac{1}{2}$ in. $\times$ 8 in. How many gallons will it hold? (163)

16. Tell how you would prove that 1 bu. is equal to about $1\frac{1}{4}$ cu. ft. (162)

17. Tell how you would prove that 1 cu. ft. is equal to about $7\frac{1}{2}$ gal. (163)

18. The diameter of a paper plate is $8\frac{3}{4}$ in. Find the circumference. (165)

19. Carl measured the circumference of a tree to be 44 in. Find the diameter. (165)

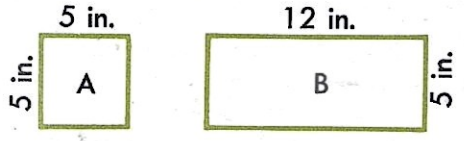
20. Jane measured the diameter and the circumference of a circle. Tell how she can figure the value of pi. (164)

## Show That You Know

*Supply the missing words and numbers. An answer must include units of measure when they are needed, as 24 sq. ft. and not just 24.*

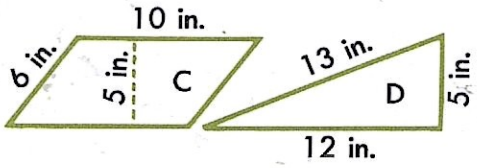
1. Figure A is a ▯, with perimeter ▯, and area ▯.

2. Figure B is a ▯, with perimeter ▯, and area ▯.



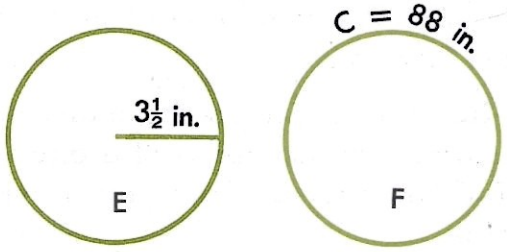

3. Figure C is a ▯, with perimeter ▯, and area ▯.

4. Figure D is a ▯, with perimeter ▯, and area ▯.




5. Find the diameter and the circumference of circle E.

6. Find the diameter and the radius of circle F.




7. How many board feet are in a piece of lumber 16 ft. long, 9 in. wide, and 2 in. thick?

8. A piece of lumber is 12 ft. long, 10 in. wide, and 1 in. thick. How much will it cost at 16¢ per board foot?

9. A box is $7\frac{1}{2}$ in. × 6 in. by 4 in. Find the volume of the box.

10. Some wooden blocks are cubes with each edge $1\frac{1}{2}$ in. The inside measurements of a box are 6 in. × $4\frac{1}{2}$ in. × 3 in. How many of the wooden blocks can be put into the box?

You know the volume of a box in cubic feet. Tell what you multiply or divide by to find —

11. How many bushels the box will hold.

12. How many gallons the box will hold.

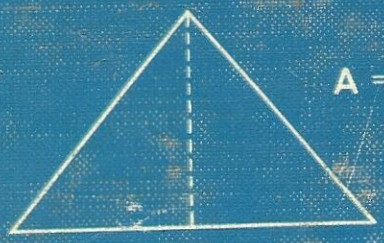
The volume of a box is 60 cu. ft.

13. The box will hold about (8; 48; 75; 450) bushels.

14. The box will hold about (8; 48; 75; 450) gallons.

15. A rectangle is 18 in. long and 12 in. wide. Each side of a square is 15 in. Which has the greater perimeter? The greater area?

TO BE CONTINUED



$$A = \frac{1}{2}bh$$

COMMUNITY BANK

PAY TO _____ $_____

_____ DOLLARS

DEPOSIT SLIP

ACCOUNT _____ DATE _____